PACIFIC DISCOVERY

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PACIFIC DISCOVERY

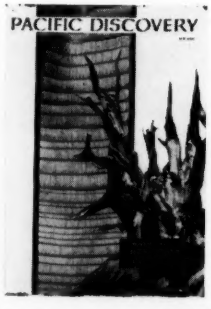
PRE-DISCOVERY

TWO ISSUES BACK, *PD's* editor, **Don Greame Kelley**, more or less promised that the tangible results of his current tour in the South Pacific will be a superabundance of copy concerning science and the activities of scientists in the Pacific area. We are expecting the first field report in any day's mail, in time for the March-April issue, we hope. To back up a little, *this* issue marks *Pacific Discovery's* tenth anniversary, an event which only something akin to a six-month tour in the Pacific area could make Don miss. On the occasion of ten years of editing *PD*, he would have quite a few words to say,-both about the past ten years and about his plans for the next decade. We'll leave the satisfactions of the past decade for Managing Editor **Robert C. Miller** to write about in succeeding pages of this issue and for Don to add to when he returns. However, a few words about future plans are in order here. Most magazines, no matter what their focus, strive always to grow bigger and better. *PD* is no exception. In the next ten years, we hope to show a material increase in both the circulation and the size of the magazine. This development would enable us not only to maintain but to improve *PD's* standards. Readers of the magazine during the next ten years can expect to see many additional features begin to appear in *PD*. Our coverage, we hope, will be greatly expanded, both geographically and editorially. As we start our tenth year, perhaps Don Kelley's reports from all over the Pacific area will start us on our expanded coverage. In the more immediate future, we also hope to receive an article from an entirely different part of the world. The article we expect is the second in our International Geophysical Year series which **J. McKim Malville** is writing for *PD*. Malville is one of the United States scientists now engaged in IGY research in Antarctica. His first article, "Men and Ships Against Weddell Sea" met with highly favorable reader response and we expect his second article – which will cover his work at the Antarctic base – will receive the same welcome.

PD'S AUTHORS

WIELDING HIS DOUBLE-PURPOSE typewriter, Managing Editor **Robert C. Miller** covers from "here to there" in this issue's editorial pages. The "here" concerns the tenth anniversary of *Pacific Discovery* which brought back to Dr. Miller's mind memories of getting the first issue out in 1948. Dr. Miller also remembers and reminds us in his editorial of the progress of *PD* since that time. Pausing only briefly, he turns his thoughts to "there," the Ninth Pacific Science Congress in Bangkok, Thailand, from which he recently returned. . . . ¶ **Lloyd G. Ingles,** a highly welcome but, unfortunately, only an occasional contributor, is head of the Life Science Division at Fresno State College in Fresno. . . . ¶ Contributor **Erwin F. Lange** writes that the photos used to illustrate his meteorite article were obtained from **Harold Johnson** of West Linn, Oregon, whose father was assigned to guard the meteorite when it was first removed from the Hughes property. . . . ¶ Our one-page article on "snake-eyes" was contributed by **M. W. F. Tweedie,** formerly with the Raffles Museum in Singapore and now living in Sussex, England. . . . ¶ **William A. Bardsley,** familiar to *PD* readers, sends his article from Tucson, Arizona, under the Western Ways Features banner, although he has now returned to New Hampshire. . . . ¶ Curator of Marineland of the Pacific in Marineland, California, is the full-time job of a newcomer to *PD's* pages, **Kenneth S. Norris.** . . . ¶ The Academy's eyes are special pets of **George W. Bunton,** Curator of Astronomy and Manager of Morrison Planetarium at the Academy. G.B.B.

IN THIS ISSUE



THE COVER

ONE OF THE WORLD'S oldest living trees, a bristlecone pine more than 4,000 years old, is superimposed against a Douglas fir tree-ring sample, enlarged about seven times, from a roof beam in the Shungopovi Hopi village in northern Arizona.

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EDITORIAL

Ten Years Before the Masthead

TEN YEARS AGO, with the issue of January-February 1948, *Pacific Discovery* was launched, with only a modest degree of fanfare but with high hopes and great ambitions on the part of its editorial crew. The cover photograph of a ship under full sail silhouetted against a sunlit sea symbolized our intention to explore far places, and our hopes for an auspicious voyage.

Not to mix metaphors – at least not till the next paragraph – a tenth anniversary constitutes something of a landmark, which we may note in order to consider how far we have come, where we are, and what course we should chart for the future.

Readers of *Pacific Discovery* who have been with us from the beginning (fellow discoverers, we might say, the more gracefully to manage this flying leap from ship to shore), have had an opportunity to read some 2000 pages of printed matter, and to enjoy or muse over nearly 3000 illustrations – photographs, drawings, maps, star charts. Our first issue was distinguished by articles by William Beebe, Olaus J. Murie, Robert T. Orr and A. Starker Leopold. Since then more than one hundred other authors have joined this excellent company.

Subjects covered have ranged from the Arctic to the Antarctic, from mountain peaks to ocean depths, from atoms to stars. Anyone who has read and remembered all of this must by this time be a person of considerable learning. Of course the editors have read it all at least three times, hence – alas! modesty compels us to terminate this line of thought without following it to its obvious and inescapable conclusion.

Our editorial columns, which started out very modestly, have expanded to fill two or even three pages. The topics treated have, if possible, been more diverse than those covered elsewhere in the magazine – academic freedom, automobiles, birds, communication, conservation, daylight saving time, entropy, evolution . . . semantics . . . Sir D'Arcy Wentworth Thompson. We have thus far avoided x, y, and z because we don't want anybody to think we are anywhere near the end of our rope – or our alphabet (confound those mixed metaphors!). But we hereby promise that, if we ever do finish the alphabet, we will start all over again at the beginning.

A bewildered reader once wrote in to inquire what possible connection there could be between an editorial on automobile design, and the purposes of a journal of man and nature in the Pacific world. Without answering that question specifically (there is a good answer, which might very possibly be the subject of a future editorial in this magazine, but is too long to go into here), we will state that our basic theory about editorials is this: A good editorial can be written only by somebody who has something to say, and an urge to say it. With that as a starting point, we have allowed wide latitude of editorial ex-

A familiar sight to most *Pacific Discovery* readers, our ship adorns the editorial pages of the first issue in *PD's* second decade. (Reprinted from the title page of The Columbus Atlas by John Bartholomew. Courtesy McGraw-Hill Book Company, Inc., New York)

pression. No editorial in *Pacific Discovery* has ever been written to fill up space.

Now that we have briefly stated our history, our purpose, and creed, we invite comments from readers. How can *Pacific Discovery* be improved?

Two years ago we sent out a questionnaire to a large list of readers. We asked such questions as, "Do you want more natural history, or more archaeology, or more travel? Do you want more editorial comment, or less? Do you want more or fewer book reviews?" In a vast majority of cases these questionnaires came back saying, in effect, "We like *Pacific Discovery* just as it is."

This is gratifying but not constructive. We want to hear from the people who start out, "I don't like. . . ." This will help us not only to please our present readers but to attract new ones, for, like most magazines, *Pacific Discovery* aspires to have more readers. The amount of work, worry and trouble that goes into the production of a single issue could serve many more readers quite as well. There are 18,000,000 people on the Pacific Coast. We would like to have one tenth of one per cent of them as new subscribers. Is this too high an objective? You readers can help us. R.C.M.

REVIEWS

From here to there in books

A Flora of the Marshes of California. By Herbert L. Mason. University of California Press, Berkeley. 1957. viii + 878 pp., hundreds of drawings, glossary. $10.00.

Herbert L. Mason's comprehensive work, five years in the preparation, was published late in 1957. It gives descriptions of the currently known species of flowering plants and ferns that occur in wet lands, including many significant as waterfowl food. Several species of plants new to science were discovered and the classifications of many genera were reorganized. The line drawings are outstanding, both for their detail and their execution. A complete review by a botanical expert will appear in the March-April *Pacific Discovery*.

N. A. 1 Looking North. N. A. 1 Looking South. Two volumes. By George R. Stewart. Houghton Mifflin Company, Boston. 1957. 401 pp., many photos, drawings. $10.

Author Stewart opens his two-volume travel book with the information that there is no highway designated as N. A. or North America 1. Yet he points out that it does exist from Alaska to Costa Rica. With that information, Stewart then takes the reader over the road, in text, occasionally a little cute; in pictures, generally excellent, and in maps, good. One volume, *Looking North*, describes the journey from the Canadian border to Circle, Alaska. The trip is always interesting and the photographs, in black and white, offer views which are not often seen by most readers. Stewart is no armchair travel writer; he spent considerable time in the areas covered in his work. He writes about the history of the road as well as about its construction and condition. The other volume, *Looking South*, is identical in makeup, except that it concerns the road from the Mexican border to Costa Rica. Readers who want to follow the routes Stewart describes will definitely benefit from reading his work.

(Continued on page 31)

Scientists in

EIGHT HUNDRED PERSONS can constitute either a small or a large gathering, depending on the standard of reference. At a football game, such an attendance would be so small as to raise doubts as to whether the game should be played at all. At a scientific conference it is a very respectable number of people, and at a scientific conference in Southeast Asia —which many conferees traveled anywhere from 5,000 to 10,000 or 12,000 miles to attend—it is a big crowd.

People who attended the Ninth Pacific Science Congress in Bangkok, Thailand, November 18 to December 9, 1957, had the experience of being part of a large crowd without any sense of being crowded. The gathering—made up of 500 foreign delegates and 300 from Thailand – met in spacious rooms, well adapted to the purpose. Every facility was provided —it almost seemed as if every wish of every delegate had been anticipated.

The opening plenary session was held in Santitham Hall, which is one of the finest auditoriums it has ever been our privilege to see. This auditorium was designed for international conferences, and there is at each seat a telephone type of dial, permitting one to listen to an address in a foreign language and to dial in on a translation in any one of six languages. This excellent facility was available, but was not used at the Ninth Pacific Science Congress, because all of the proceedings were in English.

Precisely at 10 a.m. the first plenary session was opened by the Rector of Chulalongkorn University, who introduced the Honorary President of the Congress, H. E. Pote Sarasin, Prime Minister of Thailand. In a brief but eloquent address, couched in flawless English, the Prime Minister welcomed the Congress, expressed the importance of international cooperation in science, pointed out the need for complete freedom in scientific research, and in closing emphasized the humanitarianism of science, "which is its chief reason for being, its major justification."

The Rector of the University made some telling remarks of his own. He said the Congress "has an opportunity to recognize in a practical way the duty of science to exercise its rightful stewardship over the vast treasure of accumulated scientific knowledge. . . . If the insanity of war again breaks loose . . . there will be no brilliant afterthoughts capable of calming the quarrels of the nations. There will be no civilization for science to serve."

The man who made these remarks, the Rector of the University and the President of the Congress, was Air Marshal Muni M. Vejyant-Rangsrisht. We have purposely held out his name to this point in order to explain an important detail. The Thai people have a pleasant custom of calling everybody by his first name ("Our last names are too long," one Thai informed us). Thus we learned that it was perfectly proper to address the President of the Congress simply as "Marshall

ts in Thailand

Muni," and thereafter we so addressed this distinguished, scholarly and amiable gentleman.

The Congress was held under the patronage of their Majesties King Bhumibol Aduldej and Queen Sirikit of Thailand, who in a precedent-shattering display of hospitality to a scientific gathering, entertained the entire group at a garden party at Amphorn Palace. After brief formal introductions of heads of delegations and chairmen of sections, the Royal couple mingled with and chatted with their guests a good two hours until the party was ended by the gathering darkness.

Following the opening plenary session the Congress broke up into small groups for detailed discussions. We shall not even attempt to list the sections, of which there were twenty, with various subdivisions. Perhaps those of most interest to the readers of *Pacific Discovery* were Botany, Conservation, Fisheries, Forest Resources, Geology, Oceanography, Zoology, and Museums—of which last section the present writer was chairman.

The Conservation Section dealt with subjects as diverse as the conservation of orang-outangs, polar bears, and the wild cattle of Cambodia. The Museums Section devoted itself to a discussion of the problems of running a museum in the tropics, said problems including mold, cockroaches, silverfish, termites, and the indifference of government departments. Particular attention was devoted to the special problems that might confront a science museum in Thailand, which seems to be a likely development in the near future.

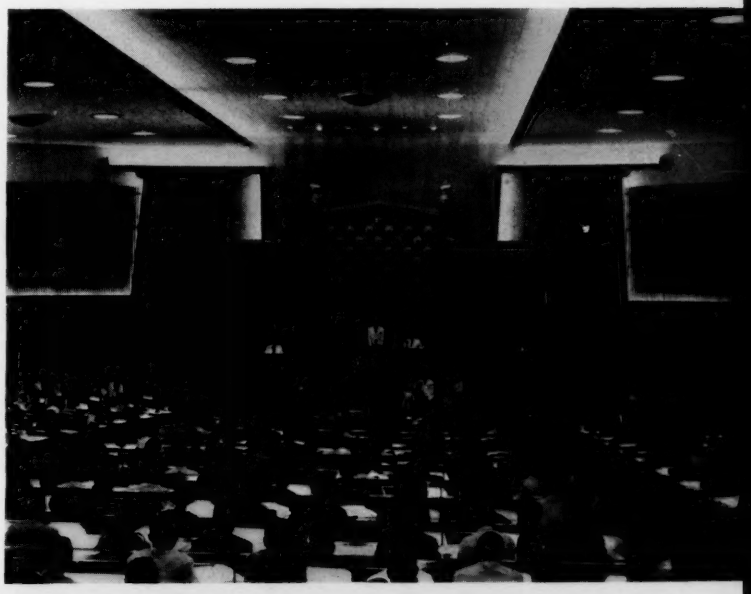
All of the sections were just as interesting. We couldn't attend them all, and if we had, we couldn't report them here because of limitations of space. At the end of two weeks of deliberations, we met for a final plenary session in Santitham Hall, at which Dr. Ian McTaggart Cowan, head of the Canadian delegation, gave a brief, brilliant address of thanks on behalf of all the foreign visitors. Then we went our several ways. What had been accomplished?

A large number of resolutions were adopted, all of them good. These will go to the various governments or other agencies concerned, and at least a good share of them will be implemented. Scientists from all over the Pacific area met with each other, renewed old acquaintances and made new ones. Five hundred foreign scientists met with three hundred Thai scientists (who knew previously that there were that many scientists in the whole of Thailand?), and received the hospitality of Bangkok – a large, modern city, with radio, television, street cars, busses, tens of thousands of automobiles, and a traffic problem comparable with that of Boston or Philadelphia.

The visitors from abroad gained a new appreciation of the Thai people – vigorous, enterprising, progressive, cheerful and, above all, friendly.

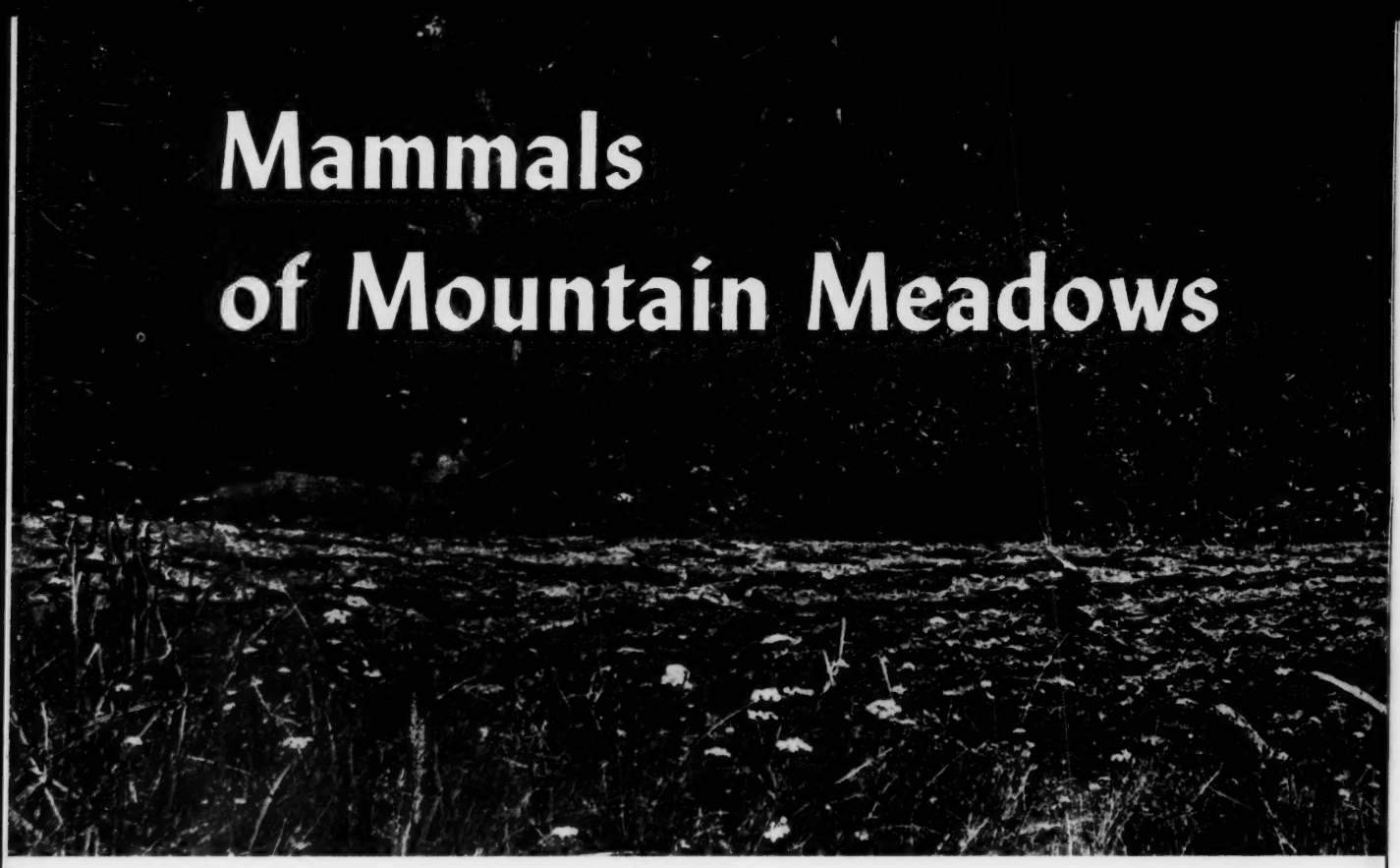
To the north of Bangkok there is a fine new stretch of highway, built with overseas aid, and known by the happy designation of "Friendship Highway." This seemed in a way to symbolize one of the main purposes of the Science Congress – to build a highway of friendship over which the many scientific problems of the Pacific area may move toward more rapid solution.

R.C.M.



(ABOVE) The interior of handsome Santitham Hall in Bangkok, Thailand where the Ninth Pacific Science Congress was held recently. The opening session of the congress was conducted in the hall. (BELOW) Managing Editor Dr. Robert C. Miller, left, shown among his fellow delegates at the science congress, focuses his attention on the proceedings.

Mammals of Mountain Meadows



BETWEEN THE RED FIR FORESTS on the precipitous slopes of Mount Shasta and the Ponderosa pines on Bear Mountain in the Tehachapis are thousands of Sierran meadows. Some of them are scarcely more than seepages or *ciénagas* about the size of a city lot where wild deer come to browse. Others comprise large ranches where pure-bred cattle graze even at midday in the lush, belly-high wild grasses.

Ranging between 2,000 and 12,000 feet in elevation, these grassy open places present a variety of landscapes of rare beauty as the seasons pass. Whatever their altitude – whether in spring, summer, fall or winter – all have one thing in common, they are placidly beautiful. In their serenity they frequently grab attention away from the quiet forest which they dot.

Yet, with all its beauty, a mountain meadow is much more than that which pleases the eye. It is more than wet soil, green plants, dazzling sunlight and browsing deer at dusk. It is a community of living beings interrelated into a unit. Just as organs and systems make up the functional body of an animal, here, the different species are parts of a functional supraorganism.

Among the less obvious, but nonetheless real species that are nearly always found in a high Sierra meadow are four little mammals that play an important role in its economy and ultimately in its rustic beauty.

One of these denizens is the Wandering shrew, among the tiniest mammals in the world. It is so small, in fact, that its diminutive body must work overtime, by the metabolic standards of larger mammals, just to keep living. It is true that the smaller a mammal is the more rapidly it loses its energy in the form of heat. Thus the little shrews not only must eat almost continuously but some of them, to maintain their body temperature, have a basal metabolic rate many times that of a man.

The Wandering shrew lives for the most part unseen at the grass roots among the wild vetch, yellow monkey flower, and shooting-star in the wettest parts of the meadow. The debris collected at the base of a willow thicket or by a single large fir log that has fallen out onto a meadow may provide sanctuary for a dozen or more of these insatiably hungry little creatures.

No one knows much about the food of Wandering shrews except that it probably consists largely

A fallen tree lies in a seemingly deserted Sierra mountain meadow. Close examination would reveal small mammals — the Wandering shrew and the Mountain meadow mouse — living in the sanctuary provided by the log. The same meadows are also the habitat of the Mountain pocket gopher and the Mountain beaver.

of soft-bodied insects, arachnids and worms. It is certain they are fond of cheese and rolled oats which are frequently used as bait.

It is a well-known fact that the birds that inhabit these mountain meadows, as well as the bats that fly over them at night, exert a leveling influence on the insect population which in some cases might otherwise destroy the meadows. Entirely overlooked, however, are the hundreds of tiny shrews that work the lower level. This is the level where the eggs, the larvae and the pupae of the insects live all winter. This is the source of food on which the shrews live throughout the coldest weather long after most of the birds and all of the bats are gone from the scene.

Without further studies we cannot begin to evaluate the true impact which a single species such as the Wandering shrew might exert on the economy of the mountain meadow. Its large numbers and almost continuous search for energy-giving food in the form of invertebrates must indeed exercise no small influence on the population of insects. The Wandering shrew must be an important cog in the big wheel which makes the meadow function as a community.

The Mountain meadow mouse is another rarely seen small mammal that inhabits in large numbers the deep grasses and sedges, especially in the damper places. Although it is many times larger than the Wandering shrew, with which it is nearly always associated, it too feeds during most of its waking hours. It is active both night and day. It feeds largely on various herbaceous plants through which it cuts long sinuous runways and tunnels. Through these passages the Mountain meadow mouse moves like a mechanical toy with incredible speed.

During winter this little rodent continues its activity beneath the deep snow as it feeds on the stems of the plants. Occasionally it will strip the bark from young willow shoots. Sometimes these highly prolific creatures occupy about every available yard of space in a meadow and it is the nature of their numerous burrows and runways that makes their chief contribution to the economy of the meadow. Their burrows open up the sod which allows surface water to sink deeper and more air to enter the soil. Their runways are strewn from one end to the other with green fecal pellets and rich nitrogenous urine, both of which stimulate plant growth.

It would be interesting, indeed, to remove all

Tiny as he is, the ubiquitous and ever-hungry Wandering shrew exercises no small control over the insect population. (Photos by the author)

of the Mountain meadow mice from a small meadow and allow no others to enter for a number of years. What would happen if there were no more "natural plowing" of the tough, water-soaked sod? What would be the effect if this continuous rich source of animal fertilizer were excluded? We do not now know the answers to such questions but it seems reasonable to believe the meadow would indeed be far different if there were no meadow mice present.

In the Sierra, the *Aplodontia* usually lives in small colonies under the willows, alders or creek dogwood in the wetter parts of the meadow. It is active diurnally as well as nocturnally, feeding on such plants as wild vetch, yellow monkey flower and shooting-star. Sometimes, near the end of summer, the animal actually cuts and makes little piles of these and other plants in sunny open places. When they dry, these plants are later transported underground, or under a nearby rock where they are stored as food. The Mountain beaver feeds for only about 30 minutes at a time, after which it retires to its nest where it sleeps for three and a half to four hours before emerging again. It has a regular place for its privy where a pile of hundreds of half inch long pellets may be deposited. The animal urinates as it eats usually while sitting in running water.

Among the willow seepages is another much larger rodent that leaves his mark on the mountain meadows. This is the Mountain beaver or *Aplodontia*. This curious dusky brown mammal is a little larger than a guinea pig which it somewhat resembles because of its very short, inconspicuous tail. It is actually only very distantly related to the true beavers. It is the only species belonging to what is probably the most primitive living rodent family.

The burrows of the Mountain beaver are large and frequently penetrate to a depth of three or

Only rarely seen on the surface, the Mountain pocket gopher is the number one excavator of the mountain meadows.

four feet. Not infrequently, there is water trickling down the burrow which drains the willows sufficiently to allow grasses to grow. Many other plants may invade the willow area after the drainage becomes well established. Like the Mountain meadow mouse, the Mountain beaver constructs grassy runways, 50 yards long or more, to reach a cluster of shooting-star or other desirable food plants. On one occasion, a 60-yard-long burrow was dug from the den through snow five feet deep to a young Red Fir tree about 5 feet tall that was completely snow-covered. The tree had been stripped of all its needles and bark. Other such trees were noted around other colonies after the snow had melted and it is suggested that the *Aplodontia* may possibly inhibit the encroachment of firs onto the meadows. Although the Mountain beaver is not as ubiquitous as the Mountain meadow mouse or the Wandering shrew in its distribution, there is no doubt that it definitely changes the appearance of the part of the meadow that it has invaded.

The most important of the small mammals living in the mountain meadows as far as the meadow itself is concerned is the Mountain pocket gopher. It is seldom seen on the surface although the large piles of fresh earth which it pushes out of its underground burrow are familiar sights to nearly everyone.

Except during the breeding season, the Mountain pocket gopher is a solitary animal and lives alone in its burrow system which may vary from 200 to 2,000 square feet or more. It feeds on the roots, bulbs and tubers that it runs into as it digs or that grow down into the burrow. Sometimes it will dare to venture a few feet from its open door to snatch a favorite plant which it drags along as it rushes madly backwards to the security of its den.

When winter comes the Mountain pocket gopher lays out a new burrow system between the

As the snow melts in spring, the elaborate system of earthern cores pushed up by the Mountain pocket gopher remains.

snow and the ground where it feeds on the stems of grasses and other plants. The uneaten dead ends of the grass are used to line the snow tunnel or may be used to construct a ball-shaped nest a foot or more in diameter in the snow itself. The melting snow discloses the nest and usually a privy with thousands of pellets only a few inches away. With the melting of the snow, the pocket gopher must resort again to its earthen burrow which always needs enlarging and renovating after a winter of vacancy.

The earth is once more pushed out of the burrows; this time up into the snow burrows. When the snow melts, these long earthen cores – sometimes up to 35 feet or more in length–are left lying over the ground, even across logs and rocks. These earth cores are often a source of speculation among those unfamiliar with them.

Although a Mountain pocket gopher will frequently push mud out of its burrow, it much prefers to live in the drier parts of the meadow. Its continual burrowing exerts a great influence on the meadow. Ten pocket gophers per acre is not an unusual number in some mountain meadows. Each animal brings up about 100 pounds of earth per week which in the snow-less months actually amounts to tons of earth brought up to filter into the grass roots and mix with the dead vegetative materials to enrich the soil.

The pocket gopher burrows affect the meadow in other ways. The flood water from melting snows sinks readily into them and such water is thus saved from the spring run-off, insuring a steady flow of springs farther down the mountain. Over the well-drained pocket gopher burrow systems grasses and forbs grow instead of sedges. Pocket gophers change the meadow appearance perhaps more than any other native animal.

Beneath the green mantle of every mountain meadow lives a multitude of rarely-seen furry creatures. They take food and shelter from their environment, but in so doing, inadvertently create conditions which give the meadow its richness and its floral variety. All of this makes the Sierra meadow a source of restful pleasure for human eyes.

(TOP) To survive, the Wandering shrew must feed almost continually on invertebrate fauna in the meadows.

(CENTER) Another of the mammals common to the meadows, the Mountain meadow mouse provides his own highways by making long tunnels in the grass.

(BOTTOM) The Mountain beaver is not as numerous as his neighbors but his deep burrows in the willow seepages definitely affect the appearance of the meadows.

"Snake-Eyes"

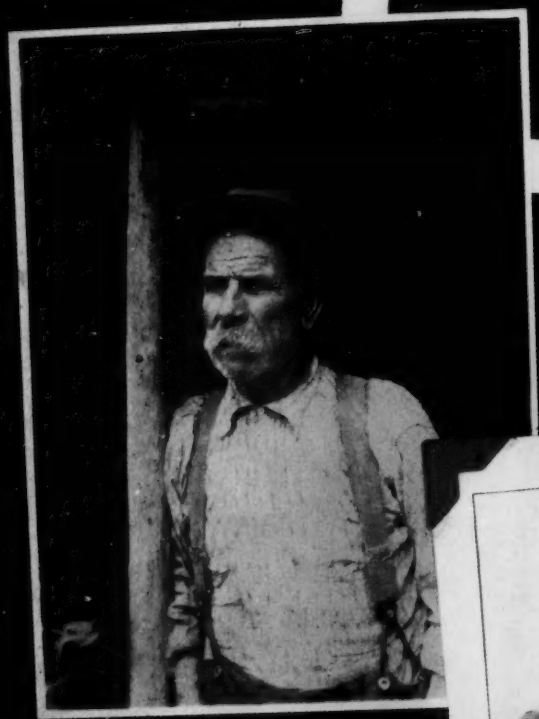
Photos and text by
M. W. F. Tweedie

IN MOST VERTEBRATE ANIMALS, changes in light intensity cause the pupils of the eyes to contract and dilate. Man's eye is "stopped down" much like the lens of a camera: the aperture remains circular. Animals in the cat family have the ability to contract their pupils to vertical slits.

Certain snakes of the genus *Dryophis*, occurring in various parts of Asia, possess horizontally contractile pupils. The upper photograph shows a living specimen of the Grass-green Whip Snake (*Dryophis prasinus*) whose eye is open wide in response to a flashlight in a darkened room. At bottom, a photograph of the same snake shows what happens when the eye is exposed to strong photo-flood illumination.

THE CASE OF THE S

Erwin F. Lange



E STOLEN METEORITE

IT SEEMS INCREDIBLE that a man, his 15-year-old son, and his horse could steal a 15.5-ton meteorite and move it three-fourths of a mile over rough and forested ground. Yet in this theft, that of the largest meteorite ever found in the United States, lies one of the strangest stories in scientific history. The theft also initiated some of the most unusual court cases in Oregon's judiciary history.

Over the years Willamette, Oregon, a small village at the confluence of the Tualatin River with the Willamette River (about 13 miles south of Portland) and now a part of the incorporated city of West Linn, had been a quiet and peaceful place to live. Nothing very exciting ever seemed to happen there. Suddenly, late in 1903 people from Oregon City, Portland, and surrounding towns began to stream out to the farm of Ellis Hughes to view a most unusual meteorite. Soon experts in meteoritics were to travel across the country to make scientific reports on this large meteorite.

Ellis Hughes, once a Welsh miner, lived on a small farm purchased from the Oregon Iron and Steel Company. In the fall of 1902, he found an iron mass on land owned by the company in a very sparsely settled area. In 1937 Mr. Hughes recounted the finding of the meteorite:

I was coming back from work where I had been cutting wood for the Willamette school. I saw this big rock, but didn't think anything of it. I'd never seen it before. The next day when I came from work I saw half a broken saw lying near the rock. It was very rusty. Evidently some woodsman had dropped it there. I sat

↑ After its removal from the Hughes property, the Willamette meteorite was moved to Portland, and it is shown here during the journey. This photo and the others Author Lange illustrates his article with are used through the courtesy of Harold Johnson, of West Linn, Oregon, whose father was assigned to guard the meteorite during the move.

← (TOP) Shortly after he discovered the meteorite, Ellis Hughes built this wagon for its removal. In the background is Bill Dale; the man in the foreground is unidentified. (CENTER) The master meteorite-mover himself, Ellis Hughes, in a photograph taken in 1937, five years before his death. (BOTTOM) The top side of the meteorite as Hughes discovered it. The holes and depressions were probably worn in the meteorite after it hit the earth.

down on the rock. It was about 1½ feet above the ground and very flat.

Bill Dale came by and said, "Hughes, have you seen this rock before?"

"Yes," I said, "I saw it yesterday."

Then I picked up a large white stone and started to hammer on the rock. It rang like a bell.

"Hughes," Dale said to me, "I'll bet that is a meteor."

It would probably be there yet, but my wife had ideas. She was afraid somebody would go up and get it the next day.

During the summer of 1903, Mr. Hughes made preparations to move the huge stone to his own property. That a steep wooded hillside and a deep canyon separated his farm from the meteorite did not discourage him but challenged him more. From the fir trees of the forest he fashioned a crude wagon. Sections sawn from tree trunks served as wheels and 10-foot poles formed the bed of the wagon. A 100-foot cable was braided from wire and a capstan or windlass was built to aid in the moving. A roadway was hewn out of the woods and several hundred feet were purposely cut in the wrong direction so that neighbors would not find out what he was doing. The utmost secrecy surrounded every detail of the tremendous task Mr. Hughes had planned for himself and his son.

The Willamette meteorite, as it became known, is bell-shaped and was found with the flattened part of the bell upward. Very laboriously Hughes jacked up the great meteorite and with his cable, capstan, and horse was able to turn the huge mass over so that the flattened side fell directly where he wanted it – on the bed of his wagon.

Then began the slow and toilsome move through the forest. One end of the cable was attached to the wagon and the other to the capstan. The capstan was fastened to the trees of the forest with a heavy chain. The horse was driven in an endless path around the capstan, thereby applying a terrific force on the cable. At other times the cable was attached to trees to keep the wagon and its precious load from rushing down the hillside. For the most part progress in moving was slow. Some days brought complete discouragement. As the fall rains started, the ground became soft and the heavily loaded wagon began to sink in the dirt. Boards were then used for a track on which the valued cargo might ride. A movement of 50 yards was the greatest progress realized in any one day. Finally after three months of toil the prized meteorite rested in the yard of Ellis Hughes.

(For centuries people have marveled at the ability of the ancient Egyptians in moving large rocks to form the giant pyramids along the Nile. The great pyramid of Gizeh has become known as one of the wonders of the ancient world. Yet the stones used in building this pyramid average but two to three tons and only the very largest approach the weight of the Willamette meteorite. In magnitude and ingenuity, the accomplishment of Hughes surpasses the work of the ancient Egyptians who performed their task with unlimited manpower.)

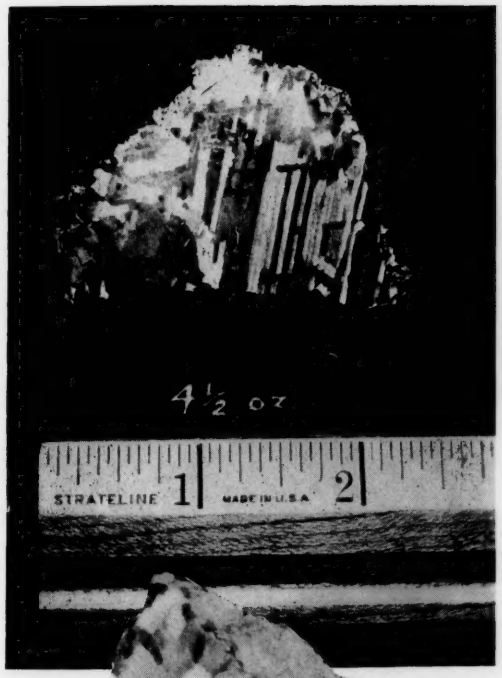
Now Hughes built a wooden shed over the meteorite and charged the curious people, who rode out to Willamette on the since discontinued street car, 25 cents admission to see his valued treasure. Among the viewers was an attorney for the Oregon Iron and Steel Company, and it did not take him long to see that the newly cut path led to his company's land which was for sale at $17.50 an acre.

On November 27, 1903, the Oregon Iron and Steel Company sued Ellis Hughes in the circuit court at Oregon City for possession of the meteorite. The company's claim to the meteorite was on the basis that it was part of the land on which it was found and had been stolen by Hughes. Hughes contended that the meteorite was an abandoned Indian relic which had been left there by the Clackamas Indians. In support of his contention he brought in two Indian witnesses. The first was Susap, a Klickitat who testified that he first saw the meteorite as a boy and that old Chief Wachimo of the Clackamas tribe had told him that young chiefs of the tribe were sent there at night to wash their faces in the water which collected in the holes of the rock. Before going to war they also dipped their arrows in the water. He further testified that the Indians called it "Tomonowos," meaning a visitor from the moon. The next witness was Sol Clark, a Wasco Indian, who was born and raised near Oregon City. He testified that the rock belonged to the medicine men of the extinct Clackamas tribe and had been in use about thirty years earlier.

The Indian witnesses had little effect on the jury, however, which ruled in favor of the Oregon Iron and Steel Company. The verdict concluded with the words ". . . and we further assess the value of the said property at ($150) one hundred and fifty dollars."

During the early months of 1904, Hughes appeared in court to appeal his case to the Oregon State Supreme Court and also petitioned to release

➔ Different specimens of the Willamette meteorite show entirely different patterns. The highly polished sample at the top — a specimen owned by Harold Johnson — reveals long bars of various shades while the lower sample, from the University of Oregon collection, although treated in much the same way, exhibits a completely unrelated pattern.

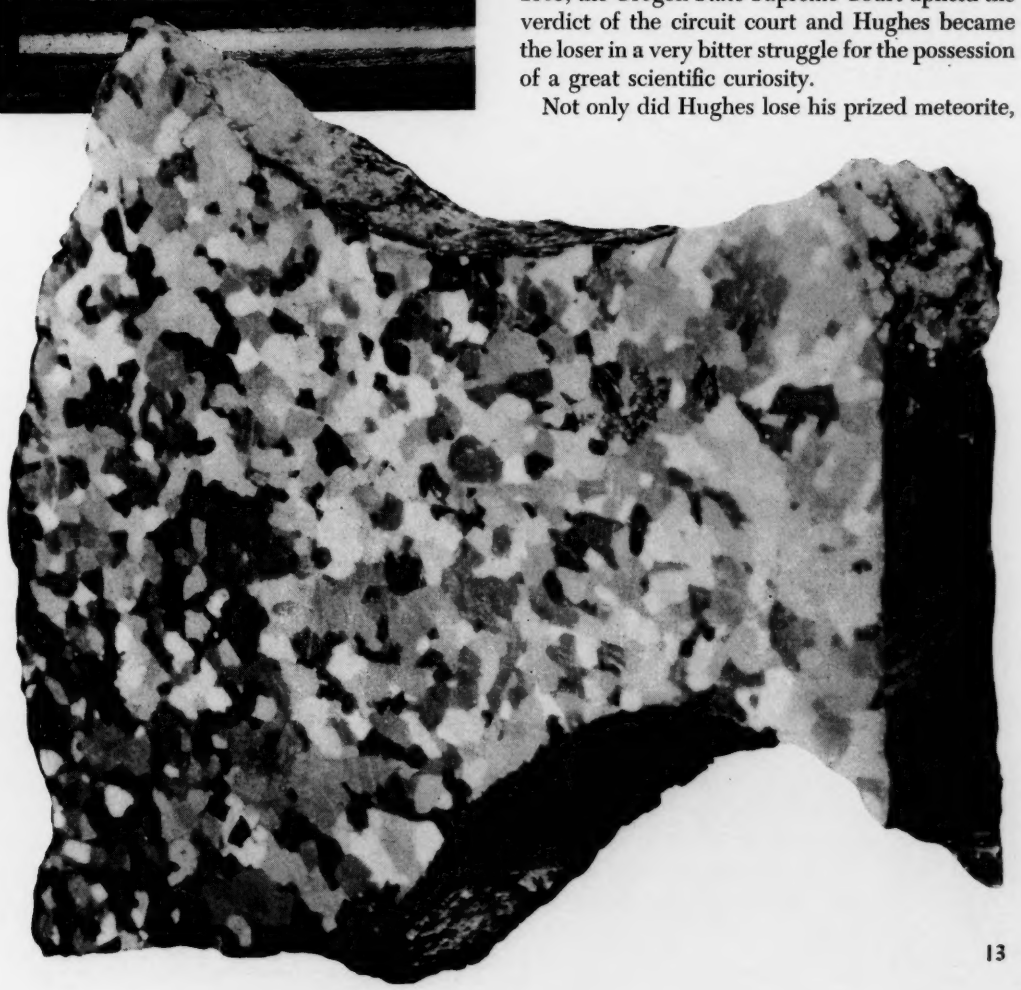


his firm of attorneys and to engage a new lawyer.

Then a strange event took place. The attorneys who represented Hughes in his case in the circuit court found new clients in Rudolph Koerner and Fred Meyers, neighbors of Ellis Hughes, who now sued for possession of the meteorite, and Hughes found himself as co-defendant with the Oregon Iron and Steel Company. It was reported that the new clients even produced a crater (by blasting) to show the jury where the meteorite originally fell. On January 19, 1905, the new jury in returning its verdict again awarded the meteorite to the Oregon Iron and Steel Company and concluded the verdict with the words ". . . and we assess the value of the said property at $10,000."

During the early summer months of 1905, the appeal was heard before the Oregon State Supreme Court, Hughes now being represented by both of his former firms of attorneys. On July 17, 1905, the Oregon State Supreme Court upheld the verdict of the circuit court and Hughes became the loser in a very bitter struggle for the possession of a great scientific curiosity.

Not only did Hughes lose his prized meteorite,



Today, Willamette — now incorporated into the city of West Linn — looks like this. On one of its hills, here partly obscured by haze, Ellis Hughes found the famed meteorite and moved it to his property.

but a few months later as he went to Portland a stranger accosted him with the request for change for a $100 bill. To this Hughes complied and on the following day, September 21, 1905, he attempted to buy groceries from his storekeeper in Willamette, only to find that he had accepted a $100 note of the "Confederate States of America."

During the last part of July and the first part of August, the Oregon Iron and Steel Company began the task of moving the massive meteorite to Portland where it was to be exhibited at the Lewis and Clark Centennial Exposition. It was placed on a huge sled and crews of six men each and two teams of heavy draft horses worked night and day in order to place the meteorite on a barge at the mouth of the Tualatin River to be floated down the Willamette River to Portland. At the beginning of the moving a newspaper account estimated that ten days would be required to move the large mass about two miles to the river.

On August 23, 1905 the Willamette meteorite rested in the Mines and Mineral building of the Lewis and Clark World's Fair in Portland. On that day a gala unveiling took place. Several hundred people and dignitaries gathered in the Mines building to watch Dr. Charles Walcott, director of the U. S. Geological Survey, withdraw a large American flag which was draped around the huge mass of iron and nickel. This was followed by a series of talks by a group of outstanding speakers. Senator Thomas R. Carter of Montana, a national authority on mining, spoke on geological surveys by the U. S. Government. Professor Robert H. Richards of the Massachusetts Institute of Technology lectured on the black sand deposits of Oregon as possible sources of metals. Professor O. F. Stafford of the mining department of the University of Oregon concluded the program with a history of this now-famous Willamette meteorite.

At the Lewis and Clark exposition the huge meteorite attracted large crowds daily during the few remaining weeks of the fair. Among the visitors was Mrs. William Dodge II of New York, who being greatly impressed by the huge rock, negotiated with the Oregon Iron and Steel Company

for its purchase. A newspaper account reported the selling price as $26,000. Mrs. Dodge presented the meteorite to the American Museum of Natural History in New York City which has ever since retained its ownership.

While the main mass of this celestial wonder rests in New York amid a collection of other great meteorites, pieces have found their way to many museums in this country and Europe. Among these are the U. S. National Museum, the Chicago Natural History Museum, Michigan University, and the University of Oregon. A number of private collectors have likewise been able to obtain pieces. In recent years the site at which the Willamette meteorite was found has been visited by many amateur and professional astronomers and geologists. Some of these visitors have continued to excavate the small crater from which the large meteorite was removed. A considerable amount of meteoritic oxide crust has been taken from the crater and much of it has been sold to commercial firms dealing in scientific specimens and supplies. Samples of this may be purchased for about $1.50 per ounce.

Meanwhile, Ellis Hughes continued to live a simple life as an obscure farmer on the place which brought him momentary fame in the annals of scientific and judiciary history. All of his life he harbored a bitterness over the justice administered him by the courts of Oregon. On December 3, 1942, Ellis Hughes, age 83, died suddenly. Although little remembered by his community in later years, his name will be perpetuated throughout the scientific world as the finder and loser of the largest meteorite ever to be found in the United States.

The mouth of the Tualatin River where the Willamette meteorite was loaded on a barge — after several days of moving it overland to the stream — and floated down the Willamette River to Portland.

Obtaining a tree-ring specimen, a University of Arizona tree-ring research worker is framed against the vegetation-studded mountains of Arizona.

DENDROCHRONOLOGY: *K*

ains of Arizona.

Key to the Past

WILLIAM A. BARDSLEY

ON THE SUMMER OF 1956 three trees were found on 14,000-foot White Mountain Peak, east of the Sierra Nevada in California, which turned out to be four thousand years old. The publicity following this discovery of what may well be the world's oldest living things brought renewed attention to dendrochronology, the study of annual tree-ring growth sequences and patterns.

Articles about old trees and exact dating of Indian ruins have appeared in many popular publications. But these have not often covered the background behind the big news stories. What then is the history and what are the methods of this quiet science centered in the Southwest, a region becoming better known as testing ground for more spectacular twentieth century developments in the form of nuclear explosions and guided missiles?

Young astronomer Dr. Andrew Ellicott Douglass came from the East to the Lowell Observatory at Flagstaff, Arizona, late in the nineteenth century to take up the study of sunspots, a subject that particularly interested him. Seeking to establish some correlation between sunspots and the earth's climate, he turned to examination of tree-rings.

For centuries it had been recognized that tree-rings presented a record of annual growth. What Dr. Douglass hoped to find was that by measuring the varying sizes of rings he could establish a record of past climate. Dr. Douglass was not the first to attempt to study tree-rings. But he was more successful than his predecessors, and his early efforts were the beginning of what has developed into the precise science of dendrochronology.

Dendrochronology is based on the fact that several varieties of conifers in their annual growth period, which normally occurs between late spring and mid-summer, produce cells that differ in color and density according to the stage of the season. The growth process occurs between the xylem, or wood section of the tree and the bark. Growth consists of the building up of successive annual layers formed by cell production. Early in the growing season the new cells developing are large and light in color. As the season nears its end, cells develop more slowly, becoming compressed and darker. The final cells produced before growth ceases form a hard sheath which encloses the new ring and marks its outer edge with a sharply defined dark line.

Photos by Western Ways Features

It was Dr. Douglass's good fortune that he began his search for tree-rings in the Southwest. There were four factors in the area to aid him. Had any one of these been missing it would have been impossible to establish the 2,000-year chronology that now exists for the Colorado River basin.

Not all trees produce annual rings, but Dr. Douglass found several conifers growing in lower mountain forests of the Southwest that do. Most work up to this time has been done with the Douglas-fir *(Pseudotsuga taxifolia)*, western yellow pine *(Pinus ponderosa)* and piñon pine *(P. edulis)*. Considerable early work was done with the giant sequoia *(Sequoia gigantea)* in California, but in recent years little time has been devoted to the species chiefly because its rings are not sensitive enough to climate to be of much use in new studies.

A second point favoring the Southwest is that tree growth must depend on a single climatic factor if it is to produce a readable record of climate. Solar radiation, temperature, and humidity are relatively constant in the area. Significant variations appear only in the amount of moisture introduced into the soil. Therefore, it was possible to conclude that, where roots do not tap the water table, tree growth is dependent upon annual rainfall.

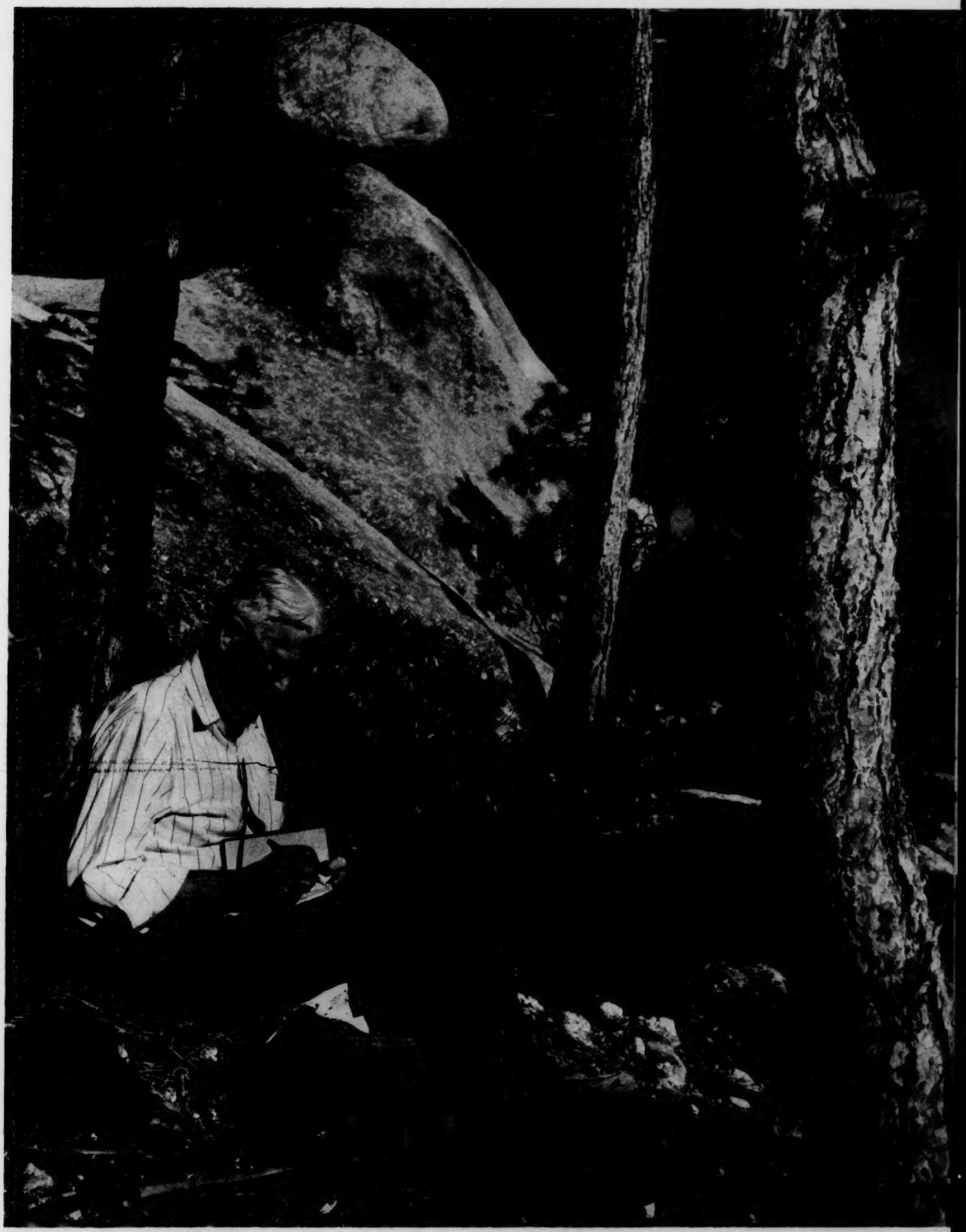
To extend an area's tree-ring chronology beyond the age of living trees, it is necessary that there have been a prehistoric native population which used wood. The pueblo-building Indians of the Southwest satisfy this requirement. Their ancient construction timbers and firewood have proved invaluable to the studies of modern dendrochronologists.

Finally, of course, the wood used by the prehistoric population must have been preserved so the rings are still visible. The dry atmosphere of the Southwest preserves organic matter. Exposed wood has been found that survived 1,000 years, and wood in dry caves of the region will last almost indefinitely.

Charcoal also retains ring markings for dendrochronologists to study. Good specimens are obtained from fire pits and also from roof timbers that caught fire and then collapsed, the fire being smothered by the roof's covering of mud before the wood's cell structure was destroyed.

Dendrochronology has been developed to a considerable extent in other parts of the world, par-

The beams in this cliff-dwelling ruin in northern Arizona are the type used by dendrochronologists to extend the southwestern tree-ring chronology to dates before the age of the oldest living trees.



Dr. Andrew E. Douglass, whose early efforts began the development of the precise science of dendrochronology, records his findings during a tree-ring specimen collecting trip.

ticularly Scandinavia, Great Britain, central Europe, and Alaska. European studies have dealt primarily with living trees, with occasional efforts to use timbers from old houses and ruins. Some use has been made of prehistoric remains in Alaska. In general, the region near the arctic timberline offers considerable promise for the development of tree-ring chronologies, although here the element influencing ring size is believed to be early summer temperature rather than rainfall.

Among virtually unstudied areas, the Middle East is thought to have the greatest promise. In South America, preliminary studies have been made in the southern Andes by Dr. Edmund Schulman of the University of Arizona, who feels more work there would be worthwhile. Up to this time, however, the American Southwest, with its combination of fortunate circumstances, has seen the maximum development of dendrochronology.

Naturally enough, a Southwestern school, the University of Arizona, has become the center of tree-ring studies. Dr. Douglass, now limiting many of his activities but still going at the age of 90, heads the laboratory of tree-ring research there. With his assistant, Bryant Bannister, Dr. Douglass now devotes himself to the study of climatic cycles made evident by tree-rings. Dr. Schulman is in charge of dendroclimatic studies aimed at developing the climatic records themselves.

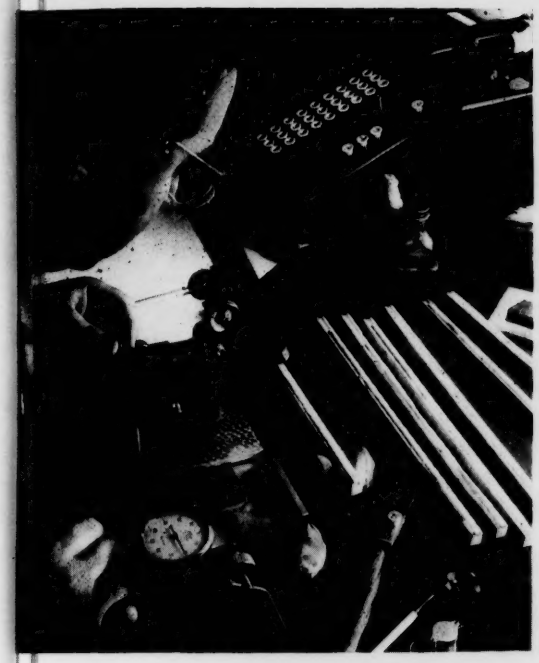
Rings of living trees are examined without damage to the tree through use of the Swedish increment borer, which extracts a core somewhat smaller in diameter than a pencil. From a stump or felled tree, a cross-section or V-cut slice is removed as a sample. Archeological timber specimens are obtained by cutting off an end or boring out a core. Delicate old wood obviously has to be handled with great care. Charcoal is a special problem and normally is preserved by soaking in a solution of gasoline and paraffin.

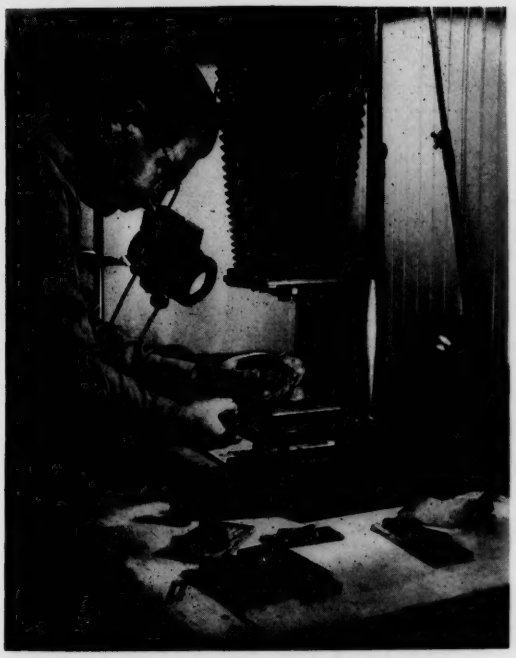
Once in the laboratory a wood or charcoal specimen is prepared for examination by being surfaced with a razor blade. It is then studied through a hand lens, the object of the observer being to determine the positions of smaller than usual rings. Memory may be used to establish a tentative date or, when the researcher is working in an unfamiliar area or period, a skeleton plot is often used. This is a sequential plot on graph paper indicating years of deficient growth. A composite skeleton plot of new specimens from a local area can be matched against a master skeleton plot to gain

(TOP) A tree-ring sample beside the tree from which it was removed.

(CENTER) Rings of living trees are examined through use of a Swedish increment borer. The tree sample is held by metal insert which fits inside drilling shaft.

(BOTTOM) From a stump, a V-cut is the easiest method to obtain a ring sample.

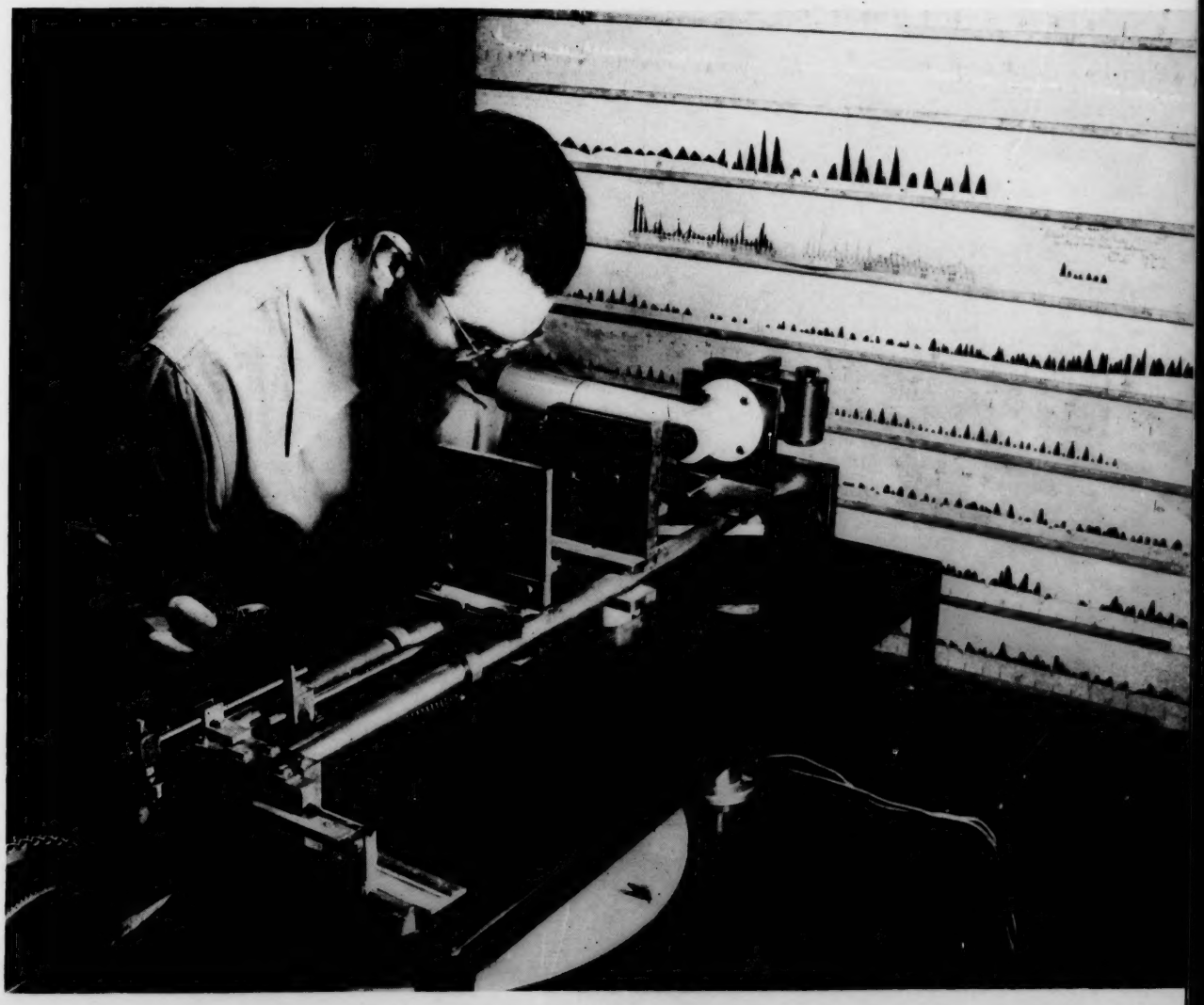


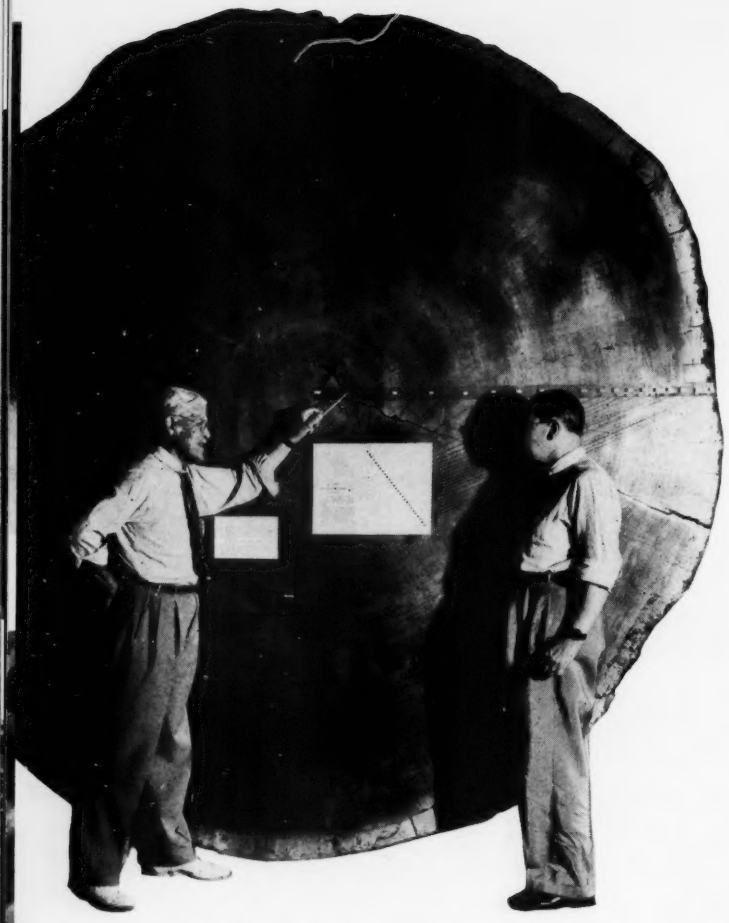


(LEFT) Tree-ring research worker measures size of tree rings with sliding micrometer.

(RIGHT) Photographing tree rings in the University of Arizona laboratory of tree-ring research.

(BELOW) With the cycloscope — an instrument invented by Dr. Douglass — an observer can determine duration of climatic cycles without having to plot them out on paper.





an indication of proper placement in the tree-ring chronology.

The skeleton plot is not considered final authority. A definite date is assigned a new specimen only after it has been compared with a number of known specimens. This is first done visually. Then measurements of the rings are made to the nearest 0.01 millimeter and the sequences plotted to scale on graph paper. A composite plot of the new specimen is drawn and compared with a previously established master plot of the particular area. Matching plots confirm the visual crossdating and are considered proof of the specimen's date. A tree-ring chronology is built by starting with modern specimens of known date and continuously crossdating with overlapping older specimens.

Dendrochronology's contribution to archeology has been widely publicized. Tree-ring study has made it possible to assign apparently definite construction dates to many Southwestern Indian ruins. This opportunity to make a positive statement about something formerly mysterious and unknown attracted much popular attention, more than any other achievement of dendrochronology.

While the contribution to archeology need not be minimized, dendrochronology has, however, produced much valuable information otherwise. Dr. Schulman has developed upper river basin chronologies for all major streams of the western United States. Rainfall fluctuations in all of these are well established for about five centuries. Maximum length chronologies published are for the Colorado, 2,009 years; for the Snake, 1,494 years, and for the Missouri, 973. According to Dr. Schulman, the drought since 1921 in the lower Southwest appears to be the worst since the thirteenth century. The Colorado basin above Lake Mead, however, evidently suffered more severe drought from 1871 to 1904 than it is now experiencing.

Dr. Douglass' work has led to the conclusion that there are definite cycles in our climate. The cycles are very irregular and show frequent variations in length. Most interesting, perhaps, is the fact that cycles, which operate over relatively small geographic areas, have on occasion apparently changed their durations over vast areas at the same time. This indicates the probability that an unknown factor creates weather cycles.

Through discovery of unusual ring growth in a timber at Wupatki ruin in northern Arizona found duplicated near the volcano Parícutin in Mexico, dendrochronology has suggested to vulcanologists the probable date for the eruption at nearby Sunset Crater. It is likely also that tree-rings ultimately will provide cross-checks for other geochronologic dating methods working in the relatively modern area, particularly pollen analysis and glacial varve studies.

An unusual modern application is found in the Navajo Indians' employment of a dendrochronologist in an effort to establish construction dates for numerous old hogans. The information is wanted for use in a land-claim case against the Government.

The recent discovery in the White Mountains northeast of Bishop, California, of trees older than any hitherto known to exist is likely to bring further advances in tree-ring chronology. Three bristlecone pines *(Pinus aristata)*, dwarfed and fantastically eroded by the ravages of time, were found near upper timberline with readable rings indicating an age of more than 4,000 years. These

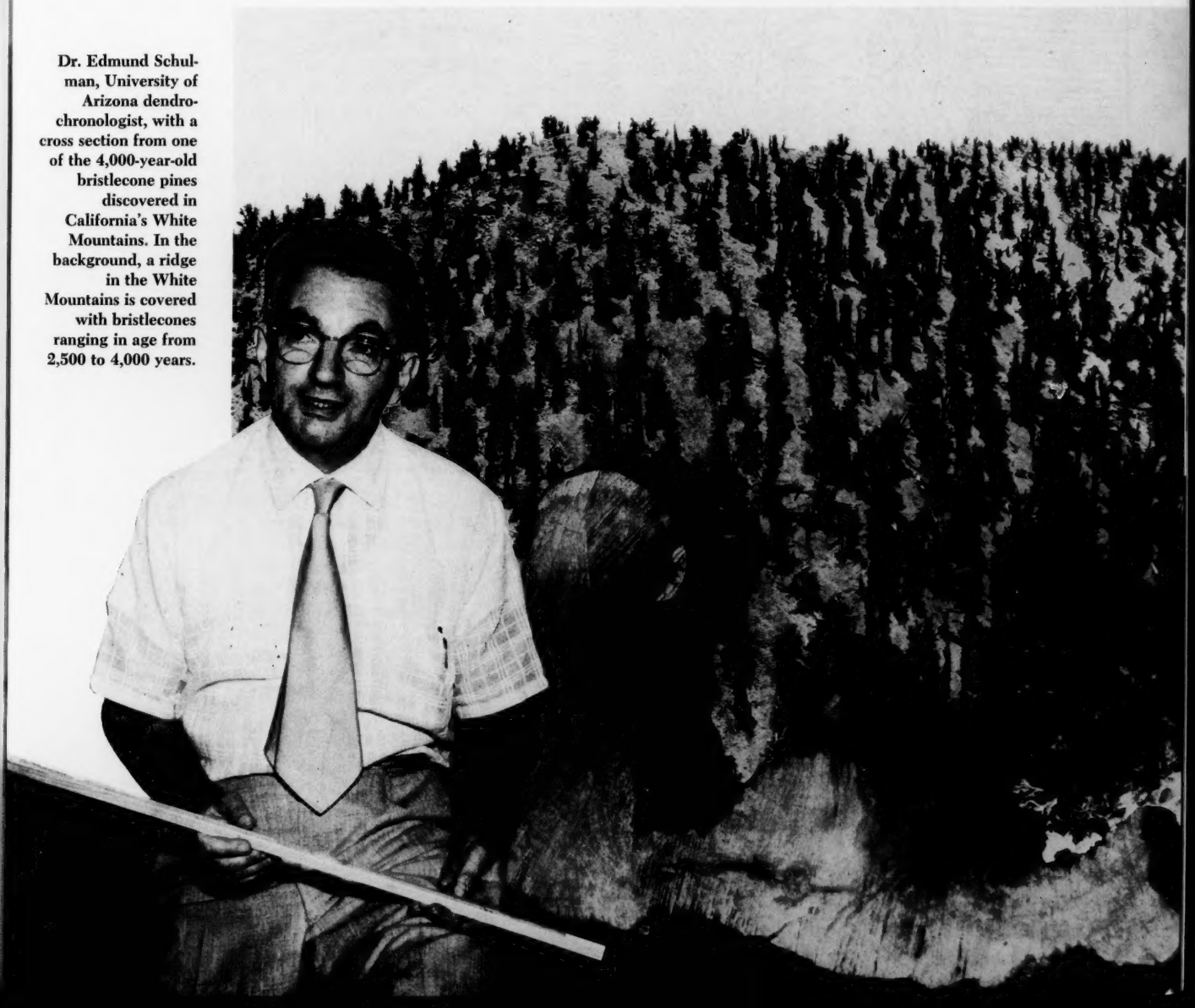
Dr. Douglass points out to associate various historical events which have been correlated with rings in a 1700-year-old giant sequoia on display in the University of Arizona Museum.

high altitude pines were generally neglected until recently because of their remoteness, apparent insensitivity to rainfall changes and unsuspected great age.

Five other bristlecones with ring records of more than 3,000 years have been found in the same area. Before these discoveries, a 3,200-year old sequoia was believed to be the world's oldest tree. Limber pines *(Pinus flexilis)*, another slow-growing high altitude species, have been found to produce many crossdatable records approaching 2,000 years.

Despite these new finds, dendrochronology is limited in its application to the past in that it can tell us nothing about times which pre-date the earliest living or preserved wood. Moreover, it is limited in geographical application by the fact that relatively few species of trees produce crossdatable rings; and a ring date provides information applicable only to its own environment.

Nevertheless, the studies originated by Dr. Douglass have provided the first method of reaching back to date exactly events in man's history other than his own written or inscribed records. They have also given us the first means of establishing a year by year record of certain elements of the earth's climate in the centuries preceding our own very modern weather records. Dendrochronology will surely have more to contribute in the future.

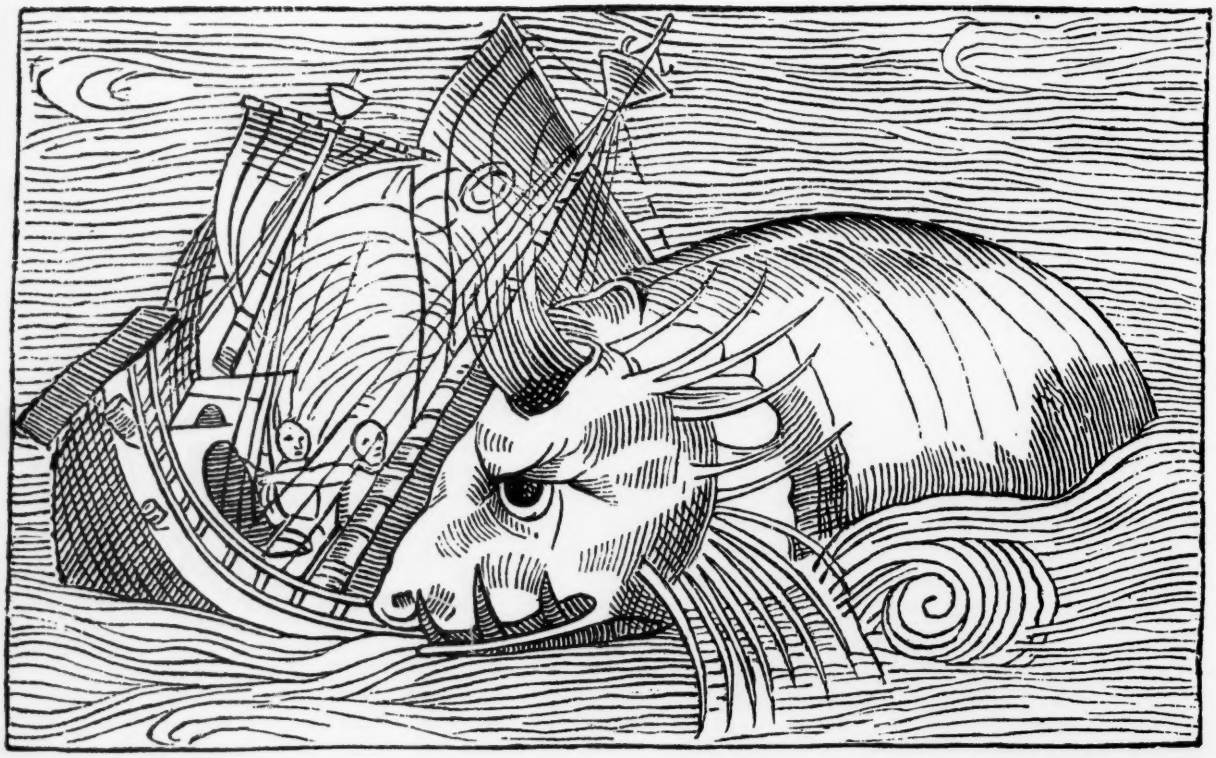


Dr. Edmund Schulman, University of Arizona dendrochronologist, with a cross section from one of the 4,000-year-old bristlecone pines discovered in California's White Mountains. In the background, a ridge in the White Mountains is covered with bristlecones ranging in age from 2,500 to 4,000 years.

FACTS AND TALES ABOUT KILLER WHALES

Kenneth S. Norris

ALONG THE CALIFORNIA COAST south of Monterey one may sometimes look out just beyond the seaward edge of the dense beds of *Nereocystis* kelp and see several fins, including a tall black one shaped like a lateen sail. It is the dorsal fin of a male Killer whale. Perhaps then, up the coast ahead of the whales, a school of sea otters may be seen frolicking in the water. Before the whales can close the gap the otters streak for the kelp and take refuge among the stipes of this dense sea forest. Some of the otters even slide up into the canopy of kelp fronds and floats and lie virtually out of water until the whales pass.



Even a brief glimpse of the Killer whale is something few will forget, because it is one of the most fabled and feared of living creatures. This fear has resulted in a mantle of almost impenetrable myth. Naturalists find it difficult to winnow truth from imagination in eye-witness reports of the Killer's habits. For example the high triangular dorsal fin of male Killers has sometimes been called a weapon for use in attacking other whales, but this is myth as the fin is without any bony support. Its tip sometimes topples limply to one side and the breeze of a brisk day can sometimes be seen to make the entire fin quiver as the whale knifes through the water. The real use of the unusually high fin is not known. Since only males

So many incredible tales have been told about the Killer whale, the drawing — although it is probably not supposed to be a Killer — might easily represent any number of fanciful deeds reported about the mammal. (Reprinted from The Universe or The Infinitely Great and The Infinitely Little by E. A. Pouchet. Charles Scribner and Company, New York.)

possess them they may enable the sexes to recognize each other.

Fabulous battles between sword-fish and Killer whales are rumored to take place. Eye-witnesses tell graphic tales of seeing the sea churned to a froth as the Killers leap and splash but no one ever seems to see the sword-fish.

Stories of Killer whales breaking through heavy ice packs to dislodge resting seals must be viewed with skepticism as thick ice generally possesses such strength that even a Killer whale could not break it. However, there is no doubt that they will crash through the thinner ice – up to two and one-half feet – at the edge of floes. A photographer with a British expedition to Antarctica tells a terrifying tale of having a floe heave up under his feet and break into pieces as the Killer whales crashed against its underside. He raced to the safety of thicker ice, with new respect for the Killer whale.

Roy Chapman Andrews, the famous naturalist of the American Museum of Natural History in New York, relates stories of great Gray whales which were attacked by Killer whales. The forty-five-foot creatures were reported to become so frightened upon the approach of the Killers that they would roll over in the water and lie motionless on their backs, in abject terror. The Killers would then gather about the Gray whales and bite at their lips and force their mouths open. Then the voracious animals forced their heads inside the gaping jaws of the larger whales and bit large portions from their tongues. Gray whales captured by Korean whalers were often attacked by the Killer whale packs and the lips and tongues eaten. Most Gray whales that were captured in Korean waters had portions of their tail flukes missing and pieces snapped from their fins. Killers are said to attack in packs. Some of them nip at the tail and fins of the prey while others station themselves at the Gray whale's head and still others pull at the lips of the huge helpless creature.

The most incredible story of all comes from a quaint little whaling station at Twofold Bay in southern Australia. The original tale was told by whalers who worked at the station. Discounting the human motives which they injected into the yarn, it remains a most remarkable story. Shore whaling at Twofold Bay has been practiced for well over a hundred years. Until 1928, men put to sea at this isolated spot in long whaling dories, rowed in pursuit of whales, harpooned and lanced them by hand, then towed their catches to port where they were rendered down in the most primitive of fashions. In this way the men of the station obtained as many as 100 whales in a season. The

▲ A big male Killer, about 25 feet long, surfaces near the Marineland collecting vessel, the *Geronimo*.

▼ An 18-foot female Killer whale inspects the stern of the *Geronimo*. The huge mammal had a large chunk of Basking shark protruding from her jaws when photographed off Montecito, Calif.

whalers doubted that they could have done so well if they had not often been helped – as they claimed – by a pack of 25 or more Killer whales. To explain how the Killers helped the whalers, let us tell the story of a single catch.

The time is winter (July). Packs of Killers have appeared at the bay as they have been doing as far back as men can remember; in fact back to the time when aboriginal whalers pursued their game from the bay. The townspeople claimed to recognize some of their old friends among the Killer pack. There was Old Tom, with the peculiarly marked dorsal fin. There was Hookey and there were Humpy and Stranger. These animals were pointed out year after year. The townsfolk swear that Old Tom was positively identified for 50 years and may have returned to this same bay winter after winter for as many as 80 years.

At dawn, so the story goes, a Humpback whale cruises slowly into the bay. The Killers become very agitated as a boat is launched and men row to the chase. The Killer pack mobs the hapless whale as she tries vainly to rush into open water and safety. They mill about her and crowd her. The light cedar craft slips up behind the struggling monster and soon the harpooner drives his steel home. "Starn all" is the cry as the oarsmen strain to bring their craft away from the thrash of the flukes which could pound their dory to splinters.

The harpoon does not kill the whale and she must be lanced for the fatal blow. As the whalers try to pull themselves up on the racing beast to thrust the lance home, the Killers are credited with a most peculiar action. Two of the pack are said to station themselves under the jaws of the great baleen whale, forcing their bodies against her and keeping her from sounding. Another two swim alongside her head, periodically throwing themselves over her blow hole. The whalers say the Killers know that this will tire the frantic animal and bring its death sooner. Soon the lance is driven home. Blood spurts from the whale's blow hole and the mortal deed has been done. One last great frenzy and the whale's body relaxes, dead upon the bloody surface of the sea.

Now comes the Killers' reward for their help. The whalers tie the harpoon line to an anchor, drop it and stroke for the home beach, leaving the Killers with the prey. The whale's jaws are supposedly pressed open while the Killers snap up that delicacy, the tongue. Some whalers claim the Killers then take the whale by its tail and flippers and drag it to the bottom. At any rate it soon sinks, only to rise again in 24 hours or so, because of the gasses of putrifaction which swell inside it. The whalers return and tow their prey ashore, where it is rendered to oil in big iron pots. They say only the lips and tongue have been eaten.

After their feast, the Killers are said to leap and play for a half hour or more. Professor W. J. Dakin of the University of Sydney has gone to great pains to document this almost unbelievable story. Much of it may be fact. However, we cannot know how accurate is the whalers' belief that the Killers consciously aided them in the chase.

The Twofold Bay whalers held these Killers in such esteem that when Old Tom came alone to the bay and died in 1930, and his body washed ashore, it was not seized and rendered for its valuable oil. Instead the whalers flensed the carcass and laboriously cleaned each bone. The skeleton was reassembled and mounted in a special building on the main street of the little town of Eden, at Twofold Bay. Zoologists say his conical teeth had been worn to rounded stubs through the years and that an old injury had left a section of jaw missing. There seems little doubt that he was more than 50 years old at his death and perhaps nearly twice that.

The Killer whale apparently attacks and kills baleen whales, walruses, narwhals, bull sea lions, and white whales, but although he has smashed boats by biting them and by leaping onto them, there seems no authenticated account of a man having been added to his fare. The modern advent of shallow-water-diving as a major sport would seem to place this clean record in a precarious position. Many places frequented by sport divers are also the natural grounds of the Killer whale. One diver from southern California tells of surfacing after exploring the ocean floor in about 60 feet of water and climbing into his two-man rubber raft, when an adult Killer surfaced close by, poking about six feet of its head out of water. The diver reports facetiously that he was still rowing when the raft was twenty feet up the beach. In another instance at Portuguese Bend, California, a group of divers swam to safety from the kelp beds moments before a pack of ten Killer whales came cruising along the rocky shore, within 150 feet of the land's edge. From the waters near La Jolla, California, sea lions have scrambled onto the beach in terror among groups of startled people, when Killer whales came in view along the coast. It seems probable that a diver or swimmer is not too unlike a seal to be in danger if he should meet face to face with a roving Killer whale.

Although several species of Killer whales have been named by scientists, there is no unequivocal evidence that there is more than one species in the oceans of the world. It is world-wide in distribution, occurring most commonly in the waters of the Arctic and Antarctic regions, but wandering into tropical seas in smaller numbers.

There is no mistaking a Killer whale if you once get a good glimpse of one. The five- or six-foot dorsal fin of the adult male is unique. Even the females, with their smaller dorsal fins, are distinctive – as are the males – in color and pattern. Generally, a white patch

➔ Killer whales sometimes leap as much as six or eight feet out of the water. This 18-foot female is just about to clear the water alongside the *Geronimo*. Note her light-colored underside. (Photos by the author)

may be seen just behind the eye of the animal, in sharp contrast to its glistening black back. A "saddle" described as maroon or gray or white in color may usually be seen just behind the dorsal fin. If you are so fortunate as to see one of these animals leap from the water, as they often do, you will note the blunt powerful head, immaculate white belly and the paddle-shaped flippers which are white underneath. Occasionally, albino individuals have been reported.

A closer glimpse of a stranded animal or one which has drowned in a fisherman's nets will allow inspection of the Killer's powerful jaws. These are equipped with from 10 to 14 pairs of large, rather blunt, conical teeth which interlock when the animal closes its jaws so that virtually no space is left between them. At the top of the animal's head is the crescentic slit of the blowhole. This and many other features brand the Killer whale as a Cetacean, or in other terms, a member of the group of animals including the whales and the dolphins and porpoises. Throughout the millions of years since the land-dwelling ancestors of these sea-going mammals first invaded the sea, the nostrils have gradually moved from the very front of the snout to a position on top of the head. This is highly advantageous for an animal dwelling entirely in the sea, as it no longer has to raise its head to breathe and can simply rise to the surface, "blow" and inhale a new breath.

The horizontal flukes of the Killer whale can propel this bulky monster through the water with great power and speed. At Deception Bay, Washington, Killers are reported to breast the running tidal current of Deception Pass with ease, while many motor boats are able to make little progress against it. A twenty-five-foot Killer whale weighing perhaps six to eight thousand pounds is able to hurl its entire bulk from the water until its tail is six or eight feet above the surface, only to crash back into the sea with a stupendous splash.

While operating out of San Diego, California, the collecting crew of Marineland of the Pacific came upon a group of five female Killer whales and one little eight-foot newborn calf. Far on the outskirts were two or three old bulls, a mile or so away. The chief collector, Frank Brocato, jumped into his pulpit on the bow, tensely awaiting a chance to snare the little animal, which had surfaced just in front of him. One old 18-foot female swam with the little animal, her great back surfacing with his as they rose together to breathe. She turned her head and peered up at the collector directly above her, while the men on deck shouted to him, "Look out, she's coming for your legs." She rose, made a pass at the line from the snare which dangled at the surface of the water and veered off the bow. In a moment, one of the old females leaped from the water toward the 37-foot ship, landing only about 20 feet from her rail. A few seconds later the leap was repeated. At this juncture one of the bulls closed in. All the females and the calf went directly to him and could not be approached again. Who knows what might have taken place if the young animal had been successfully snared?

On another occasion this same crew came upon a pack of Killers near Santa Barbara, California. The whales had found the carcasses of two 30-foot Basking sharks, which had been killed in a fisherman's net the night before. The Killers were ripping the sharks to shreds in their frenzy. Literally acres of the water were covered with bits of shark flesh and screaming sea gulls. One Killer swam directly beneath the stern of the boat while the men looked down on her from 10 feet above. She had a four-foot chunk of shark meat clenched in her jaws, protruding out both sides.

For all their ferocity, Killer whales, like most other mammals, like to play. They have been known to bat at floating objects with their tails or push them along with their heads. They have even been known to swim along with minesweepers in the Queen Charlotte Islands region of British Columbia, playing with the paravanes as they swept through the water.

Old Tom, the Killer whale of Twofold Bay, was said to cause the whalers much consternation with his playful antics. His favorite trick, it was reported, was to wait until a whale had been made fast to a harpoon. Then he would race up behind the charging beast and grasp the harpoon line in his teeth. Despite the best effort of the whalers, he sometimes was said to hold on for several minutes seemingly enjoying the free ride.

Behind the screen of fear and fables which has been cast around the Killer whale lies a fascinating and little-known creature. One day, when the facts have been thoroughly sifted from the tales, the capabilities and intelligence of the Killer may rank it high among all mammals.

A HERITAGE OF FINE INSTRUMENTS

Conducted by George W. Bunton & Charles F. Hagar

THE ASTRONOMY DEPARTMENT is the youngest of the departments of the California Academy of Sciences. Perhaps we have something to boast of in this fact. We feel like the little girl who, as the youngest of her playmates, was constantly chided as being the smallest. Finally she found an appropriate retort which silenced her friends. She made the bold statement, "Anyway, I'm the newest!"

While this department has been in existence for but five years, we have a heritage which springs from some famous names in the field of astronomy, and from the skill and ingenuity of others who, though not professional astronomers, had no less interest in the subject.

The name of James Lick is one to which Californians attach immediate recognition. It was through his generous gift to the University of California that the Lick Observatory atop Mount Hamilton owes its origin. His generosity also gave the California Academy of Sciences a financial foundation upon which it has largely rested for nearly half its lifetime.

James Lick was no astronomer. But he had a close friend who was one of the most outstanding men in the entire world in the field of practical astronomy. It was George Davidson. The name of this man is found on treatises of great importance and value even today. It was upon his suggestion that Lick provided the funds for the Lick Observatory.

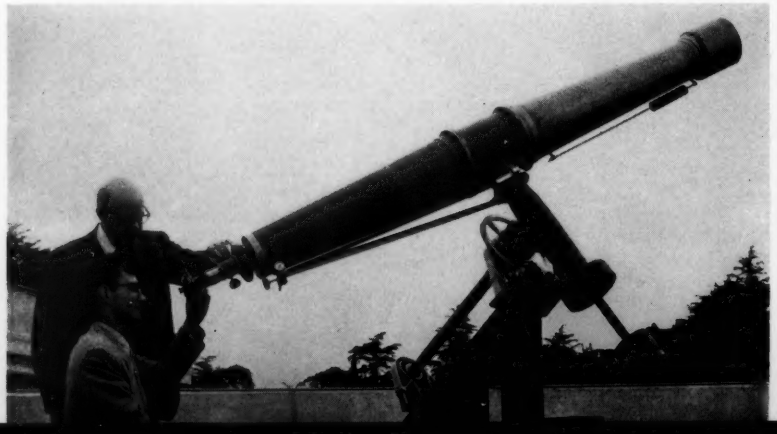
Davidson's accomplishments as astronomer, engineer, and hydrographer are most amazing. His career began as observer and computer for the Girard College Observatory when he was not yet out of his teens, and at twenty years of age he entered the service of the U. S. Coast Survey. This work took him to all sides of the continent, and it was only a few years before he was made Pacific Coast assistant to the superintendent. The survey of the state boundaries of California, the survey of the entire Pacific Coast and of the territory of Alaska must be credited to him. He made San Francisco his home and for a quarter of a century maintained and operated his private observatory on a site which is now Lafayette Square.

In that observatory were two fine instruments which now are the property of the Academy. One is a 6.4 inch telescope (made by Alvin Clark, a master lens maker), and an astronomical transit instrument with which he determined, with extreme accuracy, the longitude of the site in San Francisco. Since the creation of the Astronomy Department, these instruments have been used on two occasions in the pursuit of astronomical research. The telescope was shipped to Sweden for the eclipse of the sun in 1954. Leon Salanave used the instrument in its original tube at that time. In 1956, the lens from the same telescope was installed in a temporary wooden tube and was employed by Salanave in photographing the sun from the summit of Junipero Serra Peak near King City, California. This was the site from which George Davidson observed a total eclipse of the sun in 1880 with the same instrument. The lens from the Davidson transit instrument was used by Salanave at the same site as a guiding telescope for a larger instrument.

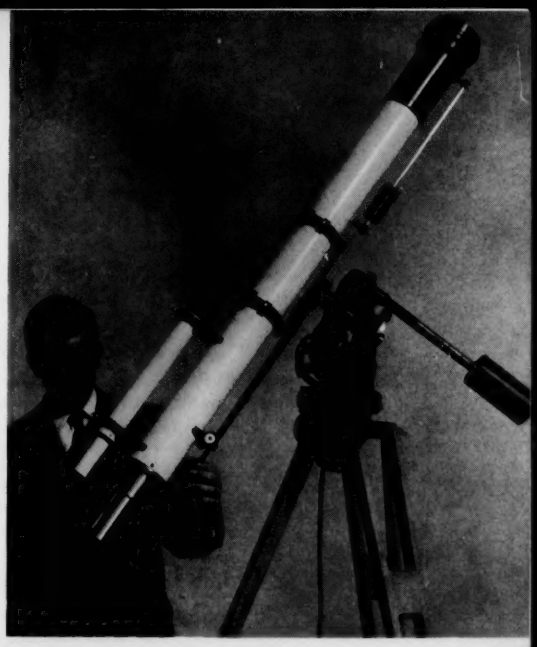
John E. Steinback, a teletype expert for Western Union, was also an expert optical worker, whose skill was gained by making himself a telescope for the pursuit of studies of variable stars. He was a close friend of Dr. G. Dallas Hanna, Curator of the Department of Geology. Just prior to the second World War, Dr. Hanna was asked to manufacture "roof prisms" for the U.S. Army. Steinback and one or two others were recruited by Dr. Hanna for this work, and Steinback's skill with the forming of glass surfaces was of invaluable service to the team. With the outbreak of the war, the work was completed for the Army, and the Navy asked the Academy group to repair optical instruments. During the war, the Academy's optical shop repaired some ten thousand optical instruments, and Steinback did much of the optical work in the shop.

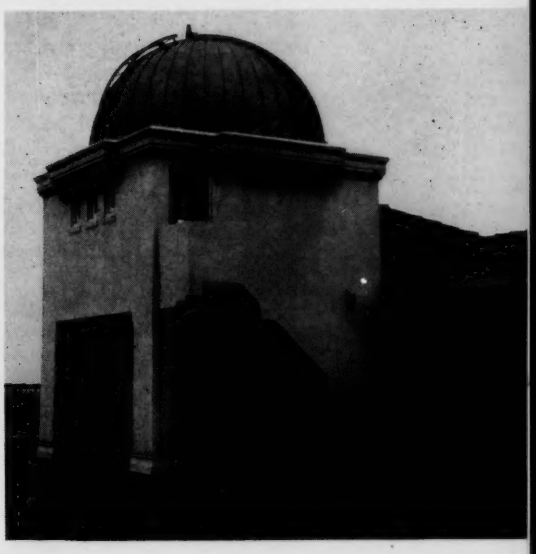
Steinback's interest and enthusiasm for the Academy's acquisition of a Planetarium did much to bring it into actuality although his death prevented his seeing it accomplished. During his association with the Academy, he was engaged in the perfection of the mirrors for a twelve and one-half inch cassegrain type telescope. When the war ended, he completed the mounting and finally realized his ambition to contribute to the amateur variable star observing program. Following his death in 1950, his telescope was presented to the Academy by Mrs. Steinback.

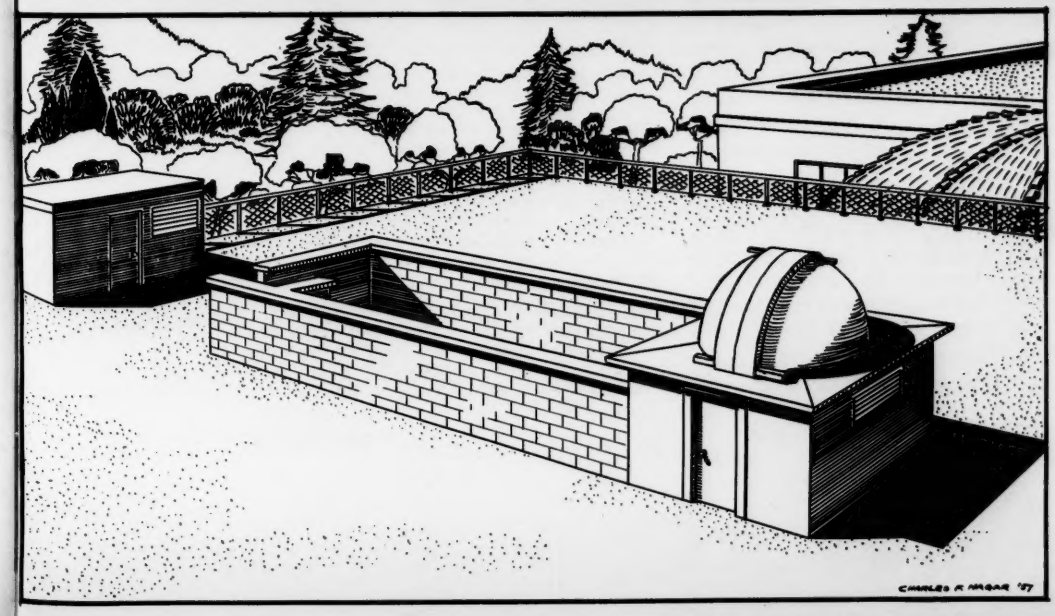
During the opposition of Mars in the late summer of 1956, the Astronomy Department set up an observing station at the top of Junipero Serra Peak in the Santa Lucia range near King City. The mirrors from the Steinback telescope were installed in a new mounting, designed and built in the instrument shop, specifically for photoelectric measurement of the brightness of Mars. The new mounting adapts itself to this work, which is similar to the variable star observation with the addition of electronic instrumentation. The excel-



Joseph Slevin, former Curator of Herpetology at the California Academy of Sciences, and Leon Salanave inspecting the eyepiece of the Davidson 6.4-inch telescope just before it was shipped to Sweden for the solar eclipse of 1954.







(UPPER LEFT) The Steinback telescope of 12.5-inch aperture atop Junipero Serra Peak during the observation of Mars in 1956. Wanda Ramey, Jane Todd on Station KCBS, peers into the guiding telescope.
(UPPER RIGHT) Donn Garriott, head usher at Morrison Planetarium, stands beside the four-inch Bausch and Lomb telescope given to the Academy by Professor Earl G. Linsley.
(RIGHT CENTER) San Francisco's Galileo High School has an excellent roof-top observatory. The dome turns easily by a hand crank.
(LEFT) An observatory to house the Academy instruments — proposed by the Astronomy Department — is shown on the roof of one of the Academy buildings. A sheltering wall — six feet high — is shown for protection of visitors and the dome's diameter is 12 feet.

lence of the optical parts of the Steinback telescope was demonstrated by some beautiful photographs of Mars which it produced. (See "Sky and Telescope," Vol. 16, No. 7, May, 1957.)

A third fine instrument was given to the Academy by Earl G. Linsley, a man well known to many people of the San Francisco Bay area. Professor Linsley taught astronomy at Mills College for many years, served as director of the Chabot Observatory in Oakland, California, and delivered a great many popular lectures on various phases of astronomy. At this writing, Professor Linsley resides in Honolulu, Hawaii, and reports that he is active in promoting astronomy in the islands, even though he has supposedly retired.

Professor Linsley is an honorary member of the Astronomy Department of the California Academy of Sciences, his title being Research Associate. He has contributed much of his time and energies to the Academy as well as gifts of books, lantern slides and equipment. One of his finest gifts is a four-inch Bausch and Lomb telescope with two complete mounting systems. One of these is a cast iron pier with an "equatorial head," and the other a tripod with "alt-azimuth" head. Recently, adapters have been made so that the equatorial head can be mounted on the tripod, and an electric clock drive has been added. This is illustrated in one of the accompanying photographs.

The Astronomy Department is fortunate, in view of its infancy, to be endowed with such an array of fine telescopes. But we are somewhat like the man with princely clothes and no place to go. These instruments are housed in the instrument shop of the Academy where they will certainly come to no harm, but are doing no one any good except on occasions such as the Mars opposition or an eclipse of the sun when they are taken out of their packing and made to perform.

Two other planetaria in the United States, Griffith in Los Angeles and Fels in Philadelphia, have roof-top observatories which are made available to their visitors. Thousands of people avail themselves of the opportunity to look at astronomical objects through the large instruments at these two institutions each year. In San Francisco, Galileo High School is equipped with an observatory dome on the roof of the school. Housed in this attractive structure is a five-inch Mogey telescope. While the equipment was not used for many years, new interest in this aspect of the educational program has recently been stirred by Albert Giegel, instructor in physics and astronomy at Galileo. The instrument is being cleaned, painted, and adjusted, and several supplementary optical devices are being constructed, all in the instrument shops in the California Academy of Sciences.

In the Astronomy Department, we have hoped and wished for an observatory structure on the roof of one of the Academy buildings for the full five years of our existence. We have never lifted our voices much above a whisper in expression of our wishes. Now we speak in full and concerted voice: Let the fine instruments left to us by our benefactors be housed and mounted in a modern observatory dome, for research, for public instruction, and for the honor of the donors! G.W.B.

SKY DIARY

January, February, March, 1958

(Pacific STANDARD Time used throughout)

Phases of the Moon

Full Moon	January 5	12:09 P.M.
Last Quarter	12	6:01 A.M.
New Moon	19	2:08 P.M.
First Quarter	27	6:16 P.M.
Full Moon	February 4	12:05 A.M.
Last Quarter	10	3:34 P.M.
New Moon	18	7:38 A.M.
First Quarter	26	12:51 P.M.
Full Moon	March 5	10:28 A.M.
Last Quarter	12	2:48 A.M.
New Moon	20	1:50 A.M.
First Quarter	28	3:18 A.M.

Meteor Showers

January 3-4—**Quadrantids:** maximum about 35 per hour on that night only. Look above northeastern horizon after midnight. Bright moon may interfere with observation.

Occultation by Moon

February 10—**Alpha Libra (Zubenelgenubi),** mag. 2.9. Time of emersion (moon uncovering star) for San Francisco: 1:57.9 A.M. Look above southeastern horizon.

The Planets

Mercury: Greatest western elongation on January 15 (mag. 0.0) and visible above the eastern horizon about 1½ hours before sunrise. In superior conjunction on March 3. Greatest eastern elongation March 28 (mag. −0.2); well placed for observation above western horizon just after sunset.

Venus: In western sky. In conjunction with moon on January 20 at 3:52 P.M. (separation 0° 40′). Disappears from evening sky on January 28 when it reaches inferior conjunction. Greatest brilliancy (mag. −4.3) on March 4; visible above eastern horizon. In conjunction with moon on March 16 at 3:00 A.M. (separation 1° 17′).

Earth: Reaches Perihelion (nearest sun) on January 3 (distance from sun: 91,500,000 miles). Spring begins on March 20 at 7:06 P.M.

Mars: Visible above southeastern horizon. In conjunction with Saturn on January 23. Rising about 4:30 A.M. by January 31, and about 3:30 A.M. by March 31 when its magnitude is + 1.1.

Jupiter: A bright object (mag. −1.5) in the morning sky. In quadrature (90° west of the sun) on January 20, rising about midnight on that date. In conjunction with moon on February 9 at 5:45 A.M. (separation 1° 40′). Begins retrograde motion on February 15. In Virgo.

Saturn: Rising in southeastern sky about 2 hours before sunrise on January 15 (mag. + 0.7). Just north of the tail of Scorpius. In conjunction with Mars on January 23 (separation 1½°). In quadrature (90° west of the sun) on March 16, rising around midnight on that date.

Roads and Trails of Olympic National Park. By Frederick Leissler. University of Washington Press, Seattle. 1957. vii + 84 pp., 19 photos, 16 maps. $1.75.

Roads and Trails of Olympic National Park is a compact, well-organized guide to perhaps the most beautiful wilderness area in the United States. Author Leissler apparently knows the park well; his information is varied and abundant. The paper-bound book is divided into three major sections, the east side of the park, the north side and the west side. In turn, the book is divided into 16 sub-sections, each of which deals with a specific area. At the back of the book are 16 maps which show the areas Leissler includes. The scores of roads and trails the author includes are far too numerous to list but an example can be given. In Map 1 Area, for example, the reader-hiker can learn that Staircase Rapids Trail starts at Staircase Resort and ends three and one half miles away at Four Stream. Approximate hiking time: 2 hours to end of trail. In this listing, as in the others, Leissler tells what the hiker can expect to see during the trek. Information such as good fishing spots, unusual scenery, camping facilities and ranger information is also included. The photographs, all in black and white, are admirably suited to point up the rare beauty the hiker will see. In short, the perfect guide for selecting and planning trips in the back country of the park. This reviewer's sole complaint is that the book was not published before he left the Pacific Northwest. (*Roads and Trails, etc.*, is published in cooperation with the Olympic Natural History Association and is the third in a series which includes *Geology of Olympic National Park* and *101 Wildflowers of Olympic National Park.*)

The Last Secrets of the Earth. By Bernard Busson and Gerard Leroy. G. P. Putnam's Sons, New York. 1957. 186 pp., 8 photos, 2 maps. $3.50.

Two French journalists have written an unusual book. They have sub-titled it *Man Confronted by the Unknown* and have set out to tell what is known about unsolved mysteries of the earth. The book is divided into seven sections. Visitors from the Sky is a good, solid reporting job about flying saucers. Information on both sides – they do or they don't exist – is clearly and fairly presented and in addition, the authors have provided some fascinating historical insights. Other sections concern the science of speleology, both undersea and on land, a consistently interesting portion. The Abominable Snowman gets his highly objective due as does the Inhuman Antarctic in other sections. Perhaps the most fascinating of all the sections is called Adam and the Coelacanth. The authors use the comparatively recent discovery or re-discovery of the Coelacanth as a take-off point for a short, lucid history of life on earth. Perhaps the only section which will disappoint the reader is called The Earth's Fire and it concerns the activities under the earth's crust. The section is somehow not as interesting as it should be. The few photographs included are excellent. A good reporting effort which adds up to a fascinating book.

Affable Savages. By Francis Huxley. The Viking Press, New York. 1957. 273 pp., 15 drawings and photos, glossary. $4.75.

An anthropologist among the Urubu Indians of Brazil is the sub-title Huxley has attached to his book: it is a subtitle which, although accurate, falls far short as a description of *Affable Savages*. Francis Huxley carries on the tradition established by his great-grandfather, Thomas Huxley; his grandfather, Leonard Huxley; his father, Julian Huxley, and his uncle, Aldous Huxley. It is a tradition of eminent capability in either some field of science or in some phase of the written arts, and usually both. Francis is obviously of the same mold; he writes simply and smoothly and, at the same time, there is every indication that he is an alert, broad-minded and tolerant anthropologist.

In several ways, Huxley's work is like no other anthropological book this reviewer has read. Of his year with the Urubus, he writes what becomes a fascinating narrative, tied together with anecdotes. In no case are the anecdotes mere parenthetical asides. They are so smoothly woven into Huxley's book that it begins to emerge as a whole even before it has been wholly read. With his anecdotes – which explore all aspects of the life and enjoyment of the Urubu Indian – Huxley makes the reader aware the Urubus are a completely human group; a vast improvement over many anthropological books which marshal rows of statistics and behavior patterns and the like and call them people.

Huxley's tolerance is amazing and heartening. He avoids no phase of the life the Urubus live. In his introduction, Huxley says, "Compared to us, Indians (Urubus) have little shame, and the result is a number of passages that are perhaps either improper or horrific. It is difficult to know how to treat such matters, and it may well seem that Urubu life is basically ignoble, and the Indians are aptly described as savages. . . . An Indian may be savage, but this does not mean that he is unprincipled."

Difficult as Huxley may have found it to treat such matters, he has succeeded in treating them well enough so that his subjects are much more fellow human beings than the subjects of anthropological study; an achievement which makes *Affable Savages* fine reading.

The Last Cannibals. By Jens Bjerre, translated from Danish by Estrid Bannister. William Morrow & Company, New York. 1957. 192 pp., maps, 76 photos. $4.50.

Jens Bjerre, a well-known young Danish explorer, has written an account of four expeditions into the primitive territories of Australia and New Guinea. He lived among the aborigines of Australia, then among the Kukukuku, the Morombo, the Kuman and the Sepik peoples of New Guinea. He observed the fantastic rituals and ceremonies of these little-known tribes and, in addition, was allowed to take extensive photographs which make an excellent visual record of what Bjerre saw.

His title refers to the habits of certain of the New Guinea tribes. One, the Kukukuku, still practices cannibalism, but only furtively, and others have only recently ceased to practice it. His explanation of the natives' cannibalism is completely practical. Bjerre writes well, the translation seems smooth, and the result is an original anthropological study and a first class adventure book. G.B.B.

The Flag Book. By Preben Kanik. M. Barrows Company, New York. 1957. 196 pp., 860 illus. in color by Wilhelm Peterson. $3.50.

To the traveler or would-be-traveler, the student of geography and history, there is a romance in flags. Today their number and variety can be perplexing. If you have difficulty in recognizing the nationality of a ship by its flag or a country represented in a parade, here in an attractive and informative handbook lies a solution. The first complete popularly-priced handbook on flags produced in this country, it includes 800 official present-day flags, some 80 national coats of arms and such additional material as historical and supranational flags. The text develops briefly the history of flags and the proper display of our own flag. Concluding the book is a 53-page section explaining, in sequence, each of the flags illustrated. J.C.K.

Space, math and weather

Practical Astronomy. By W. Schroeder. The Philosophical Library, New York. 1957. 206 pp., 18 halftones, 76 line drawings, 20 star maps, tables, scales and diagrams. $6.

Where will Saturn be in 2004 A.D.? How does one construct a sundial? How does one tell the time from the position of the Big Dipper? What is the period of light variation of the variable star Algol? These are just a few of the many questions that one may learn to answer for himself with this book in hand.

So many of the recent books on astronomy for the layman have dealt with the spectacular side of astronomy: new advances into the depths of space, galaxies, and radio astronomy. There has been need for a book that helps the layman to understand an equally intriguing side of astronomy; the determination of planetary positions, eclipses of the moon, the path of the sun, the construction of sundials, etc.

This book is probably unique in that it makes no use of mathematics for the solution of the problems. A ruler and compass, together with the tables and graphs in this book, are all that is required to provide the reader with many enjoyable hours in the comfort of the living room deciphering the mysteries of the cosmos.

The book, however, is not just for "indoor" use. There is a chapter giving helpful hints on recognizing the constellations; another on observing with the telescope; and still another valuable chapter listing and describing 140 interesting objects in the sky.

The author, who lives in England, has devoted many years to the study of the mathematical problems of astronomy and the prediction of phenomena. His other works, dealing with radio and astronomy, have met with considerable success. In the reviewer's estimation, *Practical Astronomy* will be added to the list.

Rocket Power and Space Flight. By G. Harry Stine. Henry Holt and Company, New York. 1957. 180 pp., 42 halftones, 27 line drawings, appendices. $3.75.

The headlines of today about rockets and satellites demand that the man in the street be aware of some of the fundamentals about rockets and space flight. There have been appearing an increasing number of books about the technical side of rockets. Many of these have been so filled with equations and tables that they quickly have been returned to the book shelf by most of us. There has been a need for a book that gives these basic facts about rockets in an interesting manner for the non-technical reader.

This book was written to answer thousands of questions asked by youthful and/or amateur rocket enthusiasts; people who have other livelihoods but desire to keep informed about rockets to better understand the world around them.

Stine has been at White Sands Proving ground since 1952. He has worked in rocket-engine testing and as Viking-Aerobee Project Engineer. He is a key figure in current rocket development. His book covers such topics as: the principle of the rocket; stability of rockets; types of fuel; firing rockets; how to build space stations, and the openings in rocket research for those interested. The narrative is interspersed with stories and experiences the author has picked up at White Sands, mostly to show that rocketry is both fun and serious business.

The reviewer finds that the addenda at the end of several of the chapters contains a wealth of information such as: Basic Rocket Equations; Liquid-Propellant Combinations; Aerodynamic Equations; Typical Firing Schedule, Aerobee; and Earth Satellite Orbit Characteristics.

To the enthusiast, the appendices will often be referred to because they contain a list of books and periodicals on rockets; the roster of the world's rocket, interplanetary and astronautical societies, and major United States corporations engaged in rocket research and development.

The book is not only informative but delightfully written so that it is a *must* for all who wish to keep informed about a subject that is as modern as tomorrow. C.F.H.

A Short Dictionary of Mathematics. By C. H. McDowell. Philosophical Library, New York. 1957. viii + 104 pp., drawings, diagrams and charts. $2.75.

In no respect could this highly specialized book be called an introduction to mathematics for laymen since it starts right off – with a no-nonsense air – by defining mathematical terms, many of which would mean nothing to readers not fairly well-grounded in mathematics.

But for students of mathematics and for those who use figures daily, the dictionary should serve as a practical and handy reference. The author is to be commended for his choice of language in his definitions: it explains the terms as clearly as possible. However, this won't be of much help to readers who have never before heard the term being defined.

In her short introduction, Henrietta O. Midonick writes a clear and concise short historical survey of elementary mathematics and, in the limits of the space allowed her, she covers a lot of ground and covers it well.

The dictionary is divided into two parts. Part I deals with Arithmetic and Algebra and Part II is concerned with Plane Trigonometry and Geometry. As a reference for persons immersed in these branches of mathematics or persons wishing to brush up on them, *A Short Dictionary of Mathematics* should prove invaluable. G.B.B.

Light, Vegetation and Chlorophyll. By J. Terrien, G. Truffaut, and J. Carles. Translated from the French by Madge E. Thompson. Philosophical Library, New York. 1957. 228 pp., 21 text figs. $6.00.

In a single volume, intended for the non-biologist, the publishers have combined two treatises on closely related phases of the functional biology of plants. While the book is intended for the non-biologist, technical matters are not avoided, and a little knowledge of the physical sciences is helpful to the reader. The first part, "Light and Vegetation," treats of the astronomical aspects of the illumination of the earth by sunlight, the physics of light itself, and the physical effects of light of various qualities upon vegetation. The second part, "Chlorophyll and Energy," covers the chemical aspects of plant assimilation, respiration, and photosynthesis. It is apparent that the mysteries of these phases of life are not far from definite solution.

Credit must be given the translator. The reader is always surprised at infrequent reminders that the original text was written in French.

1001 Questions Answered About the Weather. By Frank Forrester. Dodd, Mead & Co., New York. 1957. 387 pp., 3 appended tables, 20 photos, illustrative drawings, maps, etc., bibliography, and index. $6.00.

The publisher is producing a new series of "1001 questions" books covering such subjects as Insects, Birds, Astronomy, and the Seashore. *1001 Questions Answered About the Weather* is the first of the series that this reviewer has seen. If the others follow the same pattern and are as well done, this will be a fine set to add to the library of youngsters in school or of adults who are not too old to learn.

While the author has organized the material into ap-

propriate chapters, one can open the book to any page and read forward or backward, and can be sure of fascinating reading. Question No. 587: What are mock suns and moon dogs? Question No. 1024: What colleges offer meteorology courses? Question No. 254: How did the name horse latitudes originate? These are some of the questions asked and answered by the author.

Frank Forrester has been in a unique position to develop an insight into the questions and problems which are constantly arising in the minds of the layman regarding science. He was, until recently, the Deputy Manager of the Hayden Planetarium of the American Museum of Natural History in New York. His training has been in meteorology and education, a combination which shows in the fine text he has prepared. G.W.B.

Protecting the predators?

The Wild Hunters. By Gene Caesar. G. P. Putnam's Sons, New York. 1957. 248 pp., drawings. $3.75.

The Wolves, the Bears and the Big Cats are the sub-titles Author Caesar uses in his division of this generally excellent account of some episodes in America's natural history. Caesar is strongly against the extermination of predatory animals under the guise of saving other animals; and he presents a strong case for preserving the predators to save the "biotic checks and balances of nature."

Each chapter is actually a narrative of an adventure involving one of these predators. Caesar writes well and, using the animals as the central characters, he creates suspenseful and fascinating narratives. In addition, he includes general information about the animals, most of which is not too generally known. Each episode is highly diverting but the reader may become a bit wearied by stories about wolves before he reaches the end of the section. The same is true in the other sections. G.B.B.

FROM THE READER

Editor, *Pacific Discovery*

Enclosed find check for $3 for renewal to *Pacific Discovery*. It's a wonderful magazine and a monthly joy.

BESS REED PEACOCK

Los Angeles, Calif., 7 November 1957.

Editor, *Pacific Discovery*

My daughter, Margaret Bielawski, and her husband, Eugene, are subscribers to your wonderful magazine. In the September-October issue, there is a very fine article on seals, in which it states that the old bull neither eats nor drinks for two months. We are curious to know what, if anything, *do* they drink? Thanking you in advance for a reply to this question, I wish to remain

Sincerely yours,

H. M. STRONG

Napa, Calif., 19 October, 1957.

We are inviting author Karl W. Kenyon to reply in the next issue.—ED.

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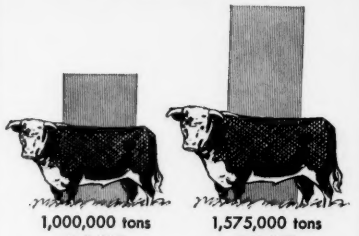

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